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Engineering News-Record

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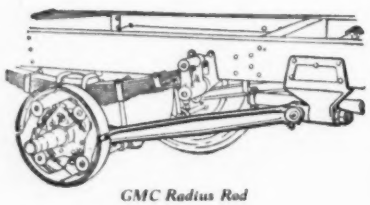

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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Standardization in the Lumber Industry

IN bringing together the producers, distributors, and users of lumber to establish standards and provide for guarantees as to sizes and grades, Secretary Hoover has added to the list of his practical services to American business. *Egineering News-Record* looks upon this proposal as another step in line with a policy it has consistently endorsed. It is to be hoped that from these conferences may issue a plan that will carry the practice of grade marking far beyond the few large mills that now employ it.

Poor Professional Tactics

PARTICIPATION in public affairs is such a new thing for engineers that a degree of ineptness must be expected before proficiency is attained. An example of how not to do it might readily be made out of the utterances of a certain local chapter of an engineering society which has felt called upon to muckrake the conduct of a municipal power project. The charges, which are being freely circulated in the local press, attack the chief engineer of the project, a prominent engineer called in from another city, because he has appointed other than local engineers as subordinates, and in so doing has not only violated the civil service law but has also grossly overpaid the men—a $5,000 construction engineer being cited as an example. Whatever the rights of the case, this is poor tactics for those whose avowed intention is to build up engineering prestige. The average citizen reading the report will see in it only the professional jealousy which, whether the animus of the report or not, sticks out of every paragraph and will have only disrespect for the quite natural office holder's attitude toward the outsider who gets an inside job. Engineers may not be any better than any other class of men in these respects, but surely the engineering profession can be but poorly served by publishing their limitations and by intimating that a $5,000 construction engineer is a superfluity on a three or four million dollar project.

Uniform Highway Markers

HIGHWAY engineers, during recent years, have been so intent upon large programs of construction that many of them have lost sight of the importance of making routes of maximum service to the traveling public. Such service does not end with the *construction* of a durable type pavement. It must include directions which facilitate the use of the highway by those who pay for it. For example, a plan of uniform numerical markings for roads throughout the New England States has been agreed to by the state highway authorities in that region. Markings are in the form of squares, painted in yellow and black on telegraph poles, carrying odd numbers for east-and-west routes and even numbers for north-and-south routes. Under the agreement reached a road extending through several states carries the *same* number. The plan for uniformity, started by the American Automobile Association, should be extended throughout the country. At present there is a great vogue among state highway departments to use colored markers or painted bands for the designation of trunk-line routes. These have been applied, for the most part, within individual states; they are meaningless except to residents and are of little aid to interstate traffic. Numerical markings are logical and have stood the test of time, particularly in France where they have reduced to a negligible quantity the inconvenience caused to highway traffic by unfamiliarity with the country. The highway traffic association, at its annual meeting, endorsed the numerical system of marking. Highway engineers can reinforce this action by getting back of the movement and extending the scheme westward from New England to the Pacific Coast.

More Study of the St. Lawrence

PROCEDURE in the matter of the St. Lawrence waterway is difficult. There are few rules and no precedents for the joint development of an international waterway. The advances toward a treaty with Canada just made by Secretary Hughes, therefore, do not mean much more than that the administration is favorably inclined toward the project and is willing to discuss with Canada the preliminaries leading up to the opening of the river to ocean going ships. If such a treaty is agreed upon by the executives there remains the legislative authorization of funds. It is imperative, however, before the last two hurdles are crossed that an extended and expert economic investigation of the project be made. Up to now all we have are heated and partisan statements from overwrought commercial and political bodies filtered through the wide mesh of the joint commission's report and an itemized estimate of cost of a given project by a board of engineers. The best thing Congress could do during the diplomatic discussions of a treaty would be to authorize an unprejudiced group of economists, shipping men and engineers to report on the possibilities and practibilities of the waterway.

A Promising Step

SIGNIFICANT possibilities are contained in the move of Cleveland contractors to clean up building conditions in that city. The same problems exist elsewhere, and an energetic precedent can be a powerful influence for good. Only last week we referred to the difficulties of the problem of getting sound building construction, chiefly with reference to the engineer's part in work where questions of strength and stability are primary. But in every city, and in Cleveland fully as much as anywhere, bad building—sometimes ignorant but more often wilfully bad—is an infinitely worse matter than design deficiencies. If unchecked, bad building infects every branch of the building art and

produces a fatally diseased condition, as is well known to building officials and others who see the process go on elsewhere. A supplementary inspection bureau, such as has been suggested in Cleveland, is an untried remedy, but one which contains great promise. It will not only supplement and make really effective the inevitably inadequate municipal inspection, but it will enroll in the fight the people most directly interested in good building. The fight surely concerns every reputable contractor, if he wants to remain reputable. But it concerns the engineer fully as much, and should engage the most active interest of Cleveland's professional men. The progress of the movement will be watched throughout the country with close interest, we feel sure.

Remolding Engineering Education

WHAT is likely in the future to be looked upon as one of the important steps in American engineering education was that initiated at Chicago week before last, when the deans of engineering schools of fourteen of the great Middle Western universities agreed to recommend to their authorities new courses with a greater content of "humanistic and fundamental subjects." The faculties have yet to approve the recommendation but the group endorsement carries a pressure that should secure favorable action. The plan is not merely the matured conclusion of a single dean and his associates, but of the leaders of engineering education throughout the virile Mississippi Valley.

The plan calls for the discontinuance of the present courses and the substitution therefor of new four-year courses in which advanced technical work will be replaced by an equivalent amount of cultural and fundamental subjects. The new courses would lead to a bachelor's degree. A fifth year of advanced work, "mostly or wholly technical and specialized to such an extent as desired" would be added and would earn an advanced degree.

Many details are still to be determined. The proportionate time alloted to the humanistic studies, the fundamental subjects which are to be expanded, and similar problems are presumably to be left to the determination of each college. How far, therefore, the new courses will be an improvement on the present ones will depend much on the judgment of the different faculties.

It will be seen that the proposal answers two demands that have become more articulate each year for at least a decade: first, that there be a larger cultural content in the courses, and, second, that there be less specialization and more attention to engineering fundamentals. These demands we have believed to be sound and we commend accordingly the new proposal.

What effect Prof. Burr's paper before the Society for the Promotion of Engineering Education had in bringing the issue to a head there is no means of knowing, but we believe it safe to surmise that it was no small factor. The plan recommended, however, differs from the Burr plan of a six-year course, half of cultural and half of engineering studies. The Western deans hold fast to four years as the desirable length of course—a wise conclusion, at least as a transition step. The alternative would have been to arrange parallel courses on the Burr plan, letting the students choose which they would. Evidently the deans believed that in expanding the humanistic and fundamental studies and restricting the advanced work they were making a course so far superior to the present ones as to warrant the elimination of the latter entirely.

The purpose of the Western action is, of course, to prepare men better fitted to carry the larger responsibilities in engineering—a sound purpose indeed, and one that should particularly concern our universities, for to them we are entitled to look for our leaders and our men of culture. It should not be forgotten, however, that the execution of engineering work requires many men who stand below the leaders in intellectual equipment and whose chief asset should be a strict discipline in those branches of engineering science required in the details of design. Heretofore many of these men have come from university schools; others from the technical institutes such as Williston, Pratt, Cooper Union and Ohio Mechanics Institute. If the university schools more and more place emphasis on training for leadership, the thinking of teachers and engineers will have to broaden in sympathy toward these other institutions on which will fall the burden of preparing for the profession a very necessary part of its complement. Running parallel with such awakening of sympathy must come an appreciation among high-school directors of the function of the technical institutes referred to so that they may be disposed to direct to such schools those of their young men whose intellectual equipment and personalities suit them better for that type of training. Thus will the requirement be fulfilled for the detailed as well as for the advanced positions in the profession.

An Undecided Case

IT is most disappointing that the jury in the long drawn out trial of the Eastern cement men for violation of the Sherman Act were unable to reach a decision. Business in general, and particularly the construction business, needs a judicial ruling on the several issues involved in that trial. The legality of trade associations, operating under the Eddy plan, is still ambiguous, in spite of the Supreme Court's hardwood decision, but this issue was thrown out of the cement case because of a technicality which establishes a precedent only insofar as it relates to the statute of limitations and its effect on a contract. The larger question as to whether the cement companies fix prices the jury could not agree upon. Eight weeks hard labor of many men and hundreds of thousands of dollars have gone for naught.

To one who sat through the case or read the record it is not surprising that the jury was confused. Here is no ordinary question of fact, no weighing of evidence to decide whether an obvious and understandable crime had been committed. The judge's charge made it clear that the crime punishable by the Sherman Act is the "unreasonable" restraint of trade. Restraint of trade, he assumed, was inherent in the practices which the cement companies freely admitted. Whether or not it was unreasonable he left to the jury, and he could give them little assistance in the definition of that word. To get twelve men to agree on a definition is well nigh impossible.

The prosecution based its case on the assumption that any deviation from the old theory of cut-throat competition in business is a violation of the law. According to that theory each competitor is at war with every other one and secrets must be as zealously guarded and as secretly sought as they are in war. And every busi-

ness act is a secret. The trade association, honestly conducted, is a revolt against the uneconomic idea of business war, which may for a time result in lower prices to the consumer but which, like all war, taxes the community out of proportion to its individual apparent benefits. The danger of the trade association lies in the ease with which community of interest can be shifted into conspiracy against the consumer in the way of monopoly control of a needed article. Between the extremes of secrecy and combination lies a proper, economic and probably legal zone. In this transition period of economic thinking, however, that zone is difficult to delimit and the recent trial leaves still doubtful whether the cement companies are operating in or out of it.

Brushing aside all generalities, what the cement consumer wants to know is whether he is paying more for cement than he ought to. That, we think, the prosecution did not prove nor the defense disprove. It was not, apparently, a legal essential of the case. The government proved that there was the closest sort of interchange of vital unformation and that there was a remarkable uniformity of price, but that that uniformity was the result of anything but the natural level-seeking of a uniform product there was no convincing evidence. Circumstantial implications of illegality were, however, great enough to warrant the trial and in the minds of some of the jury enough to keep them from rendering a verdict of not guilty. The case against the cement manufacturers is, therefore, still *sub-judice* and will not be cleared up until a retrial of the present case or the trial of the similar case against the Mid-West group.

In justice to the Portland Cement Association, it should be said that it was given a clean bill of the health. Even the prosecutor admitted in his summing up that there were no practices of that association not perfectly justified in law and in morals. It is clearly an educational institution.

Government Promotion of Foreign Trade

AMERICANS interested in foreign trade have often expressed great admiration for the assistance accorded British exporters by their government, and have been apologetic regarding our own foreign trade promotion service. But a change is in progress; and if Congress will continue to back the Department of Commerce, we shall rapidly cut down the lead which our British brethren have had through their government-supported promotion efforts.

The strides that have been made under Mr. Hoover's direction are remarkable. More specialists of high grade have been brought into the service, emphasis has been laid upon the value of immediate information, the trade representatives in Europe have had a convention to discuss their common problems and increase their grasp and effectiveness by an interchange of ideas, a closer system of direction for representatives has been established, questions that have been critical for various industries have been run down, to the great economic benefit of those industries and of the country.

At home the department has sought and has received the most satisfactory assistance from our industries. No less than seventy trade committees, representing 150 firms, are now working with the commodity divisions of the department. Thus it is possible to quickly formulate the sort of information that the industries need, and to get it while the situations are vital into the hands of the department's 1,000 agents abroad. These committees in turn see to it that when the information is collected the industry takes the matter in hand so that there will be action and definite economic results for the government's expenditure of time and money.

After a number of years in which to mature this work we may arrive at what has long been needed—the formulation by the government of a definite foreign trade policy. This would involve, of course, more than a foreign trade promotion program. It would necessarily include, for example, certain conclusions regarding the broad lines of our tariff policy. It may seem chimerical to hope for anything definite where tariff is involved, but it must not be forgotten that Congress in the end is responsible to the voice of the people and that Mr. Hoover's development of work of the Bureau of Foreign and Domestic Commerce will have the result of awakening our business men to a broad appreciation of the factors in foreign-trade building. From them a broad view of the subject will get back to Congress.

Betting on Prosperity

IN announcing a ten per cent reduction in freight rates, the Interstate Commerce Commission is not so much contributing to a revival of business as it is betting that one is close at hand. It has turned down a rational policy of substantial reductions on the raw materials of productive industry and has elected instead to slash more or less blindly into railroad revenues, hoping to achieve somehow a vague "psychological" effect that may help business along its road to recovery. If it be indeed necessary to tap the meagre earnings of the railroads for investment in American business at large, courage and prudence might suggest that the investment be made where it would do the most good, and not dissipated indiscriminately over luxuries and necessities alike. The commission has passed up a chance to perform a constructive service for American industry and business and has chosen to follow the easier way.

In view of net earnings of but 4.36 per cent for the first three months of the year, no one affects to believe that if the business revival should not materialize the roads can earn, with present volume and 10 per cent lower rates, anything like the 5.75 per cent set up by the commission as a reasonable return. Disappointment as to the revival will be disastrous to the railroads, many of which have already cut operating and maintenance costs so far as to impair their physical properties and to threaten the morale of their responsible operating and maintenance staffs.

One chance remains to reduce the hazard. The Railroad Labor Board has just handed down its answer, insofar as maintenance-of-way employees are concerned, to the application of the railroads for relief from high wages and burdensome restrictions. If this action, together with its impending decision as to other classes of labor will effect a saving commensurate with the impending loss of revenue the railroads still have a chance. There are those who reason that wages should not be dependent on revenues. A sound principle for sound conditions, but without significance in the artificial atmosphere of government regulation. Government-made wages and government-made rates have climbed hand in hand to their present eminence; hand in hand they must descend. The issue is in the hands of the Labor Board.

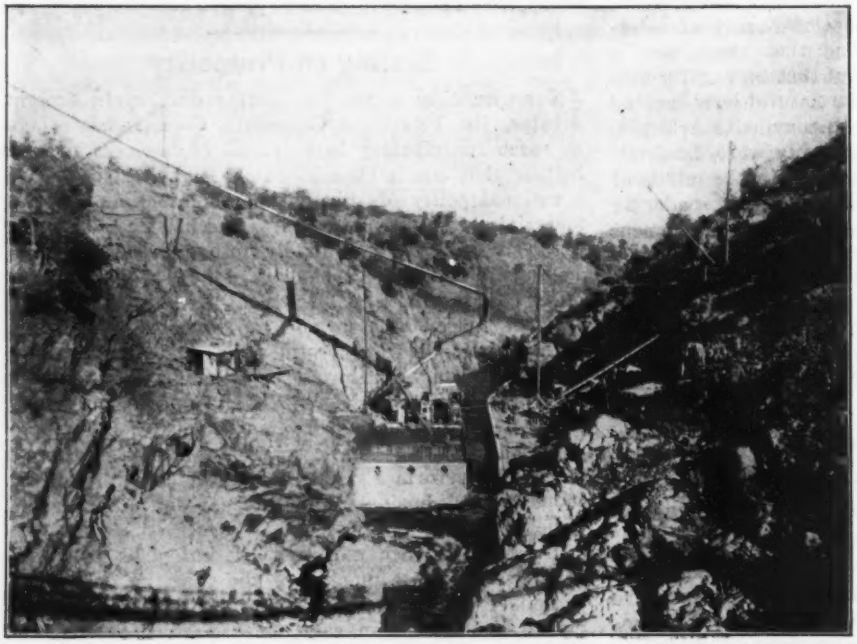
Novel Construction Features on 279-Ft. Don Pedro Dam

Large Storage Facilities—Steel Pouring Trestle Combined With Improved Chute System—Mixing Plant Delivers 1,200 Cu.Yd. of 1:11½ Concrete in 8 Hours

By R. McC. Beanfield
San Francisco, Cal.

OUTSTANDING features in the construction of the Don Pedro dam in California are unusually large material storage facilities combined with simple economical methods of material handling, a plant for mixing 1,200 cu.yd. of 1:11½ concrete in 8 hours, and the development of a new system for placing concrete in large concrete dams, involving a steel trestle partly incorporated within the dam and combined with a novel system for spouting concrete containing large sized cobbles. The layout of the construction plant is such that the path of materials entering the dam is direct, hoisting is eliminated and gravity is used to the utmost. The centralization of practically all the operations and plant units is particularly noteworthy.

Location—The Don Pedro dam site is on the Tuolumne River at the lower end of the Don Pedro bar, four miles above the La Grange diversion dam and about 60 miles below the Hetch Hetchy dam now being built by the city of San Francisco. The Don Pedro reservoir is intended to regulate the river for the joint use of the Turlock and Modesto irrigation districts. The reservoir when full will cover an area of 3,086 acres and will have a capacity of about 270,000 acre-ft.



VIEW LOOKING UPSTREAM SHOWING 20-FT. FLOOD CHANNEL THROUGH VALLEY AT SITE OF DON PEDRO DAM

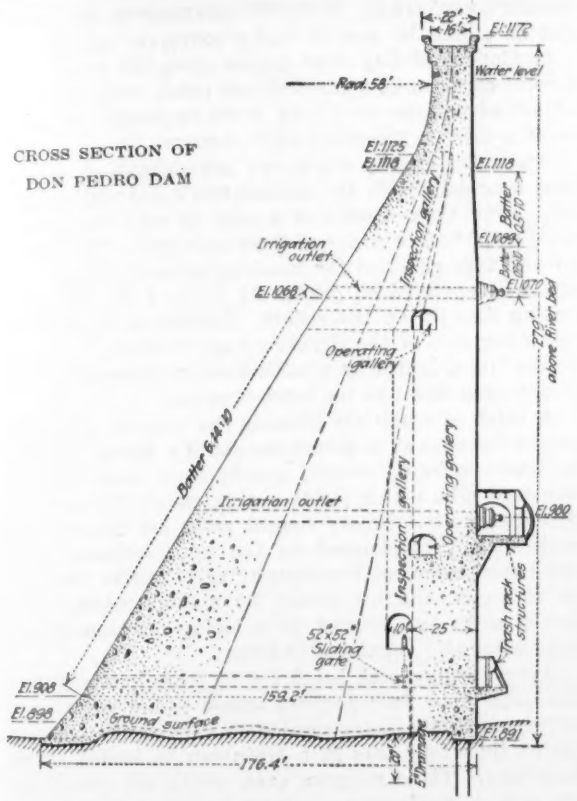
Special Features on this Dam Construction

- Large Aggregate Storage
- Steel Trestle Inside Dam
- Chute For Cobble Concrete
- Specially Built 2-yd. Mixers
- Novel Mixer Water Feed
- Rapid Concreting 1,200 cu.yd. per day Plant

Before actual construction on this job was started an unusual amount of study was put on cost analysis as well as on construction methods, design of the construction plant and camp layout. The result was the completion of detailed plans with bills of material before they were needed on the work. This policy prevented the rush that so often occurs in the preliminary phases of a large construction project with attending general inefficiencies. In fact the policy in programming the entire Don Pedro work was based on the belief that the most important problem in modern large scale construction work is the transportation problem—the efficient movement of materials from one location to another.

The dam is of the arched-gravity, non-overflow type, will contain 270,000 cu.yd. of concrete and will have a maximum height of 279 ft. above the natural river bed, which is also the extreme height of the dam since the river at this point flows upon the bare rock. The height above the natural river bed is the real measure of the comparative height of dams for utility though not for cost. In terms of height above the river bed the Don Pedro dam will be highest in the world, surpassing the Roosevelt dam by 40 ft., Elephant Butte dam by 69 ft., Shoshone dam by 36 ft., Pathfinder dan. by 61 ft., Lake Spaulding dam by 54 ft. and the Arrowrock dam by 28 ft.

Sand, gravel and cobbles are obtained from gravel bars along the bed of the Stanislaus River, 42 miles from the dam site. A segregating and washing plant designed for a capacity of 1,200 cu.yd. per day was built near the center of these beds. The segregated materials are hauled to the dam in steel hopper bottom



dump cars (ore type), of 50-ton capacity. The last 7.5 miles of the haul is via the spur of the Sierra R.R. built to serve the dam.

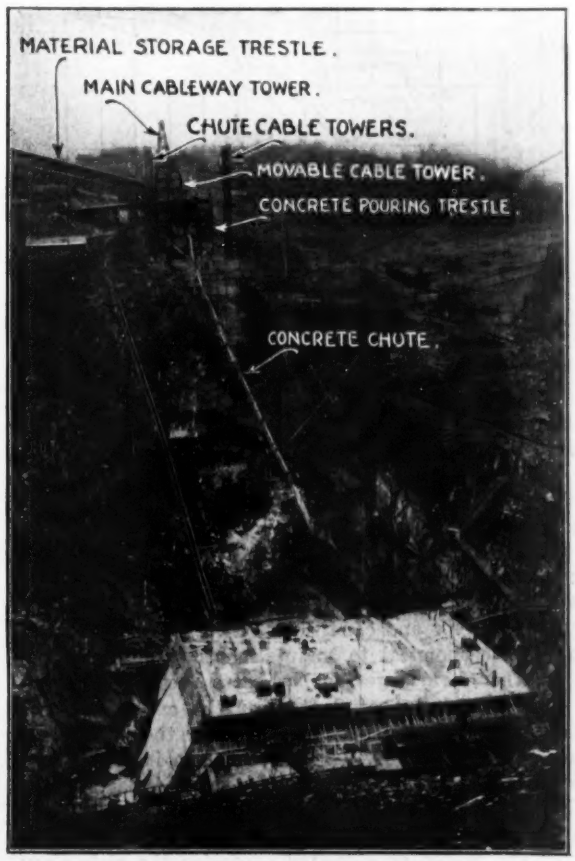
Construction Plant—In order to complete the construction of the dam within a prescribed period and because of the possibilities of delays in deliveries of materials, unusually large storage facilities at the dam-site were necessary.

Sand, gravel and cobbles delivered in train loads are dumped directly from a timber storage trestle more than 500 ft. long, and beneath which are two timber tunnels, extending the full length of the trestle. Materials dumped from the trestle are separated by transverse timber bulkheads. The storage capacity beneath the trestle is approximately 25,000 cu.yd. To expedite the unloading of the hopper cars, especially those carrying sand, portable pneumatic hammers are applied to the steel sides of the cars. These produced sufficient vibration to cause the material to discharge rapidly.

Materials from these storage piles are trapped by two gate-tenders per tunnel, through radial, over-cut gates of special design, and are measured by volume into trains of four hopper cars each. The hopper cars used for this purpose were designed to hold sufficient aggregate (82 cu.ft.) for a batch in one mixer, yielding 2½ cu.yd. of mixed concrete. Trains of four cars each are hauled by 3-ton gasoline locomotives. The tunnel gates are installed on 9-ft. centers corresponding to centers between hopper cars; so that all the cars in a train may be loaded simultaneously.

The success of these operations was seen to depend to a large extent on what may be termed small details. Some of these were the design of the tunnel gates for rapid and easy operation without jamming, large capacity equipment and elimination of heavy pressures from movable parts; a design of the steel hopper cars that would make them self-cleaning (steep slopes and rounded corners), running gears with heat-treated axles, roller bearings, spring pedestals and couplings tending to minimize maintenance and derailments. The tunnels are well ventilated to free them of dust. Air jets are used to break sand arches over the tunnel gates.

The trains of four cars from the tunnels deliver the measured batches of concrete aggregate to a set of four batch-hoppers whose centers correspond to those of the



CONSTRUCTION PLANT ON NORTH BANK

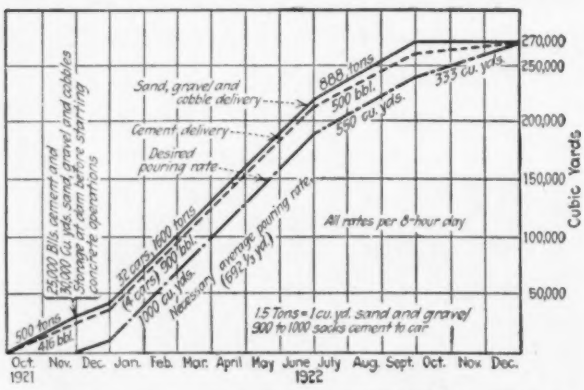
cars, thus a train of four cars can be simultaneously unloaded into the batch-hoppers and the train promptly released. Each mixer is served from either of two hoppers, thus no time is lost waiting for the makeup of the batches. Trains containing four batches can make, on the average, a round trip every four minutes.

The mixer plant contains two 2-cu.yd. concrete mixers with cast-steel drums which rotate at the rate of 14 r.p.m. These mixers were especially constructed for this project by the Norris K. Davis Co. of San Francisco, they are belt-driven from 50-hp. motors and turn on roller bearings. All the gates on the batch-hoppers and the discharge spouts on the mixers are operated by hydraulic rams controlled by 4-way valves.

The water for the concrete batches comes from automatic measuring tanks and is jetted through 4-in. pipes into the batch-hoppers. This large volume of jetted water tends to slush out the materials in the hoppers, keeps them clean and cuts down the time of empty-

ing. An auxiliary 2-in. water line is piped direct into the mixers making it possible to temper the concrete mix properly.

Difficulties in the delivery of materials due to road and railroad conditions which caused the shutdown of the plant during the period of heaviest rainfall were removed about March 1 and the plant has since then been operating eight hours daily, this being the present limit for the rate at which materials can be delivered. Since getting into full operation this spring the mixing



MATERIAL DELIVERY AND CONCRETING SCHEDULE

plant has been consistently delivering 1,200 cu.yd. per eight hours of the 1:11½ or 1:12 mix.

Concrete used in the major part of the dam consists of approximately the following proportions: 1 part cement, 2½ parts sand, 6 parts gravel (¼ to 2½ in.) and 3 parts cobbles, which measure from 2½ to 14 in. in maximum dimensions. The specifications originally called for cobbles graded from 2½ in. to 6 in.; however, due to scarcity and conditions at the gravel pit it was found uneconomical to maintain a maximum limit of 6 in., therefore larger cobbles were used.

For a thickness of 3 ft. over the entire upstream face and for a thickness of 5 ft. over the downstream face below El. 1,000, a richer concrete in the proportions of 1 part cement, 2 parts sand, 4 parts gravel (¼ to 2½ in.) and 2 parts cobbles (2½ to 14 in.) is poured. No forms are used to separate the richer mix from the leaner or standard concrete; the richer concrete is placed to about its proper distance back from the face of the dam and allowed to take its natural slope, the leaner concrete is poured against it and blends into it. Where the richer mix is used the desired number of full bags of cement is added to the standard or leaner mix, no change being made in the proportions of the other materials. Aggregate proportions are changed slightly from time to time when tests of the materials show sufficient variations in density and permeability.

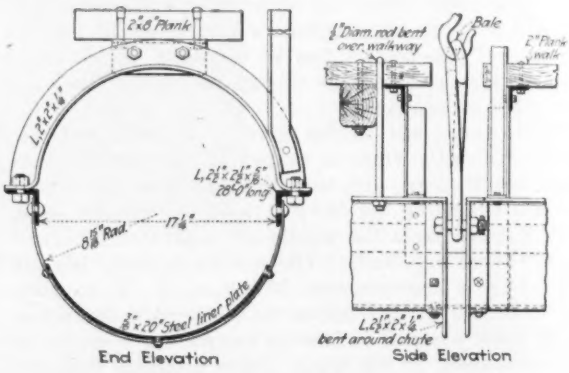
Cement Handling—Cement is delivered in bags direct from the box cars which are spotted on a trestle above and alongside the mixer house. The bags go by gravity rollers and friction chutes to a movable table alongside the batch-hoppers where the sacks are emptied by three men to each mixer. A wire screen over part of the batch-hoppers prevents empty sacks from occasionally falling into them.

Reserve storage for 25,000 bbl. of cement is provided in a storehouse located on sloping ground alongside a standard-gage track. With this arrangement all cement can be stored by gravity roller conveyors and due to a continuous sliding door system along the track side, cement cars can be spotted at any point, which permits of unloading more cars than would be possible if doors were spaced on the usual 40-ft. centers.

The roller-gravity conveyors are cleaned of cement dust once daily with air jets and lubricated with a light oil. After three months of service no wear was noticeable in the ball bearings of these conveyors. They have proved very effective for handling cement in bags and could be operated on grades 2½ in. to 1 ft., the bags rolling directly on the rollers. Cement is taken from the lower side of the storehouse on flat cars, four cars to the train, drawn by a 3-ton gasoline locomotive, and is delivered direct to the batch-hoppers.

A batch of materials entering the concrete mixers is proportioned so as to permit the use of a definite number of whole sacks of cement, usually seven sacks for the standard mix, which yields approximately 2¼ cu.yd. of mixed concrete. Empty cement sacks are cleaned in a sack shaker, constructed on the job, consisting of a revolving screen, with a capacity of 150 sacks, rotating at 20 r.p.m. and belt-driven by a 2-hp. motor. The empty sacks are bundled by a baling machine with a semi-automatic counter attachment.

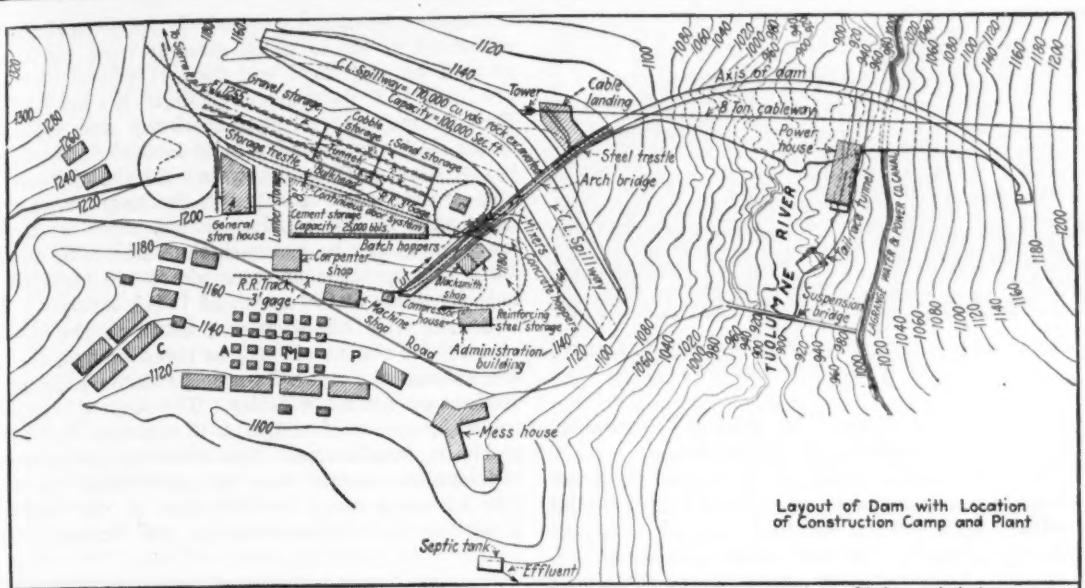
After turning each batch for 60 seconds, the mixers discharge into four hoppers whose radial gates have centers with the same spacing as cars in the concrete train; thus four cars in a train can be loaded simultaneously. These concrete cars, which are practically the same as the hopper cars used in conveying materials from the storage tunnels, deliver by dumping into steel hoppers of 10-cu.yd. capacity, located on a steel trestle

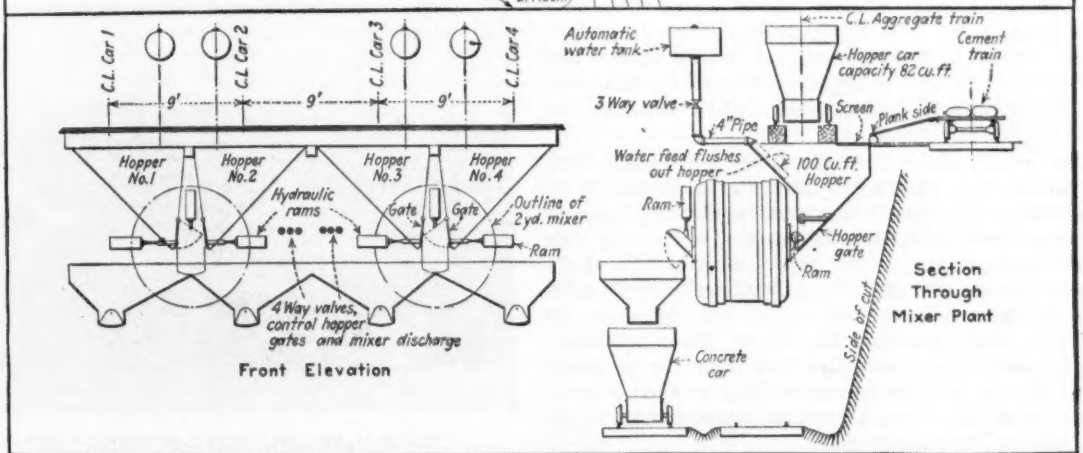


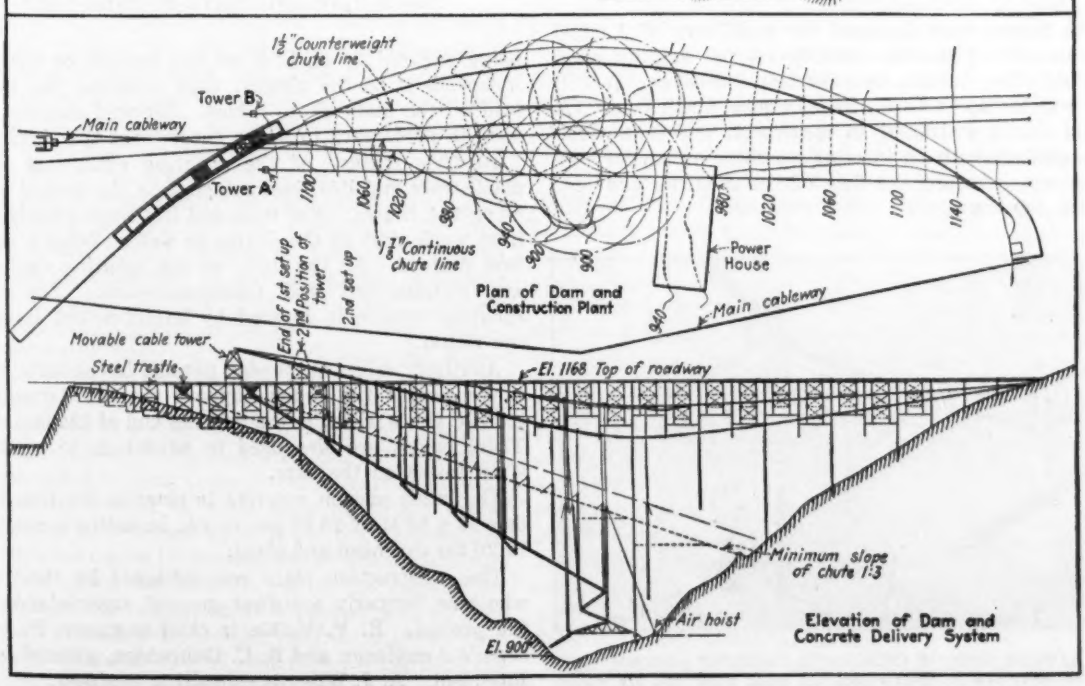
DETAILS OF CONCRETE CHUTE

which is installed in units along the axis of the dam as the work progresses.

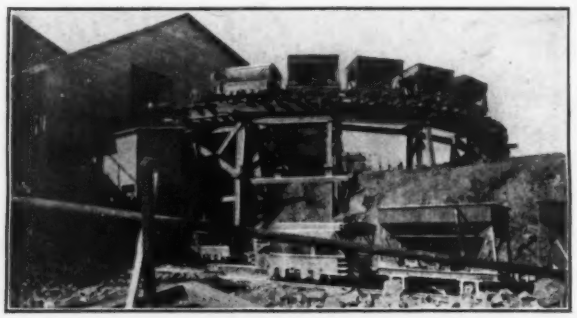
Steel Trestle System—The steel trestle is a bolted structure and in addition to carrying the concrete cars, has, at its outer end, a steel tower for supporting the main chute cables. As the sections of the dam nearest the outer end of the trestle are raised to a predetermined height, additional units consisting of completely braced bents, are added, thus lengthening the trestle. Eventually it will extend the full length of the dam. All bracing and beams are re-used, only the posts being incorporated within the dam. The braced bents are located so that they will always center between and clear the expansion joints of the dam. Erection of the steel







CAMP, PLANT AND CONCRETE MIXER LAYOUT ON THE DON PEDRO DAM—1,200 CU.YD. OF CONCRETE PER DAY



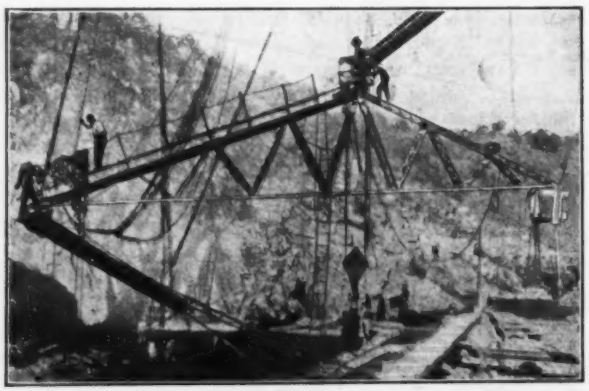
MIXER PLANT—MATERIALS ENTERING (ABOVE) AND CONCRETE LEAVING (BELOW)

trestle is greatly facilitated by having its members standardized and therefore interchangeable.

The unit-construction, steel-trestle method for pouring concrete in large dams was devised by the writer to eliminate high towers, hoisting and rehoisting of concrete, and excessive length of chutes with the attendant difficulties when handling lean mixtures containing large aggregate The steel-trestle system is simple, avoids the use of hoists in any part of the system and permits of pouring a large percentage of the total volume of the dam with the installation of the first few bents of the trestle.

Spouting System—Concrete from the trestle hoppers is fed by a radial gate into a continuous line of steel chutes. The spouting system for distributing concrete was especially designed by the writer for this project and contains many novel features. To chute distances as great as 350 ft., using lean concrete mixtures containing large cobbles, it was necessary to employ a chute cross-section whose mean hydraulic radius would give maximum velocities for a given slope. In the calculations the chute was considered 75 per cent full. For all practical purposes the result was taken as a semi-circle.

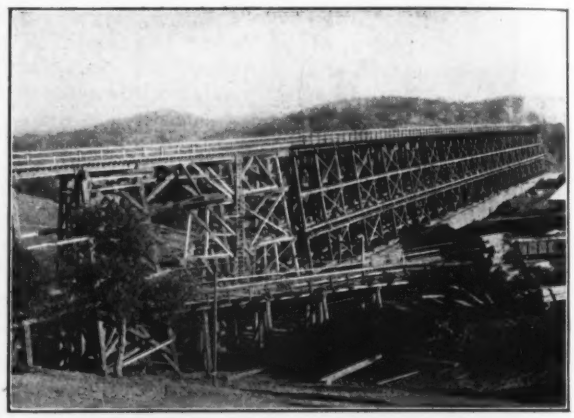
The chutes were designed for a delivery of 2 cu.yd. of concrete of normal consistency per minute on a 1 to 2¾ slope, with a cross-sectional area sufficient to pass cobbles up to 18 in. in maximum dimension. The swivel joints, universal in movement, are constructed with gimbals with no interior members or hanger rods which would retard the flow of the concrete and tend to clog the chute.



LOWER END OF CONCRETE CHUTING SYSTEM
Note strongly braced counterweighted truss, walk and life lines.

The counterweight trussed chutes were designed to withstand severe torsional stresses from tag-line pulls as well as the usual end concentrations. All chutes are lined with ⅜-in. plates of class A steel (American Steel Manufacturers' Specifications) and are secured to the chutes by key plow-bolts instead of rivets, thereby facilitating their renewals. As the bottom of the chute receives the most wear, the liner plates are cut lengthwise into two halves which, when worn on the lower parts, can be reversed, thus increasing their life. With this arrangement new plates are required, as a rule for every 30,000 cu.yd. of 1:11½ concrete.

Considerable attention was given to the details of rigging the chutes. It will be noted that all the chutes are suspended from wire-rope pendants hanging from trolleys on the main cables. The desired slope is obtained by means of tackles with two 8-in. double blocks and ⅞-in. manila rope. The wire-rope pendants saved considerable manila rope by shortening the tackles. The standing parts or fall lines of the tackles are made fast to wooden cleats on the chutes instead of



TRESTLE AT AGGREGATE STORAGE YARD

being secured to anchors on the ground or otherwise independent of the chutes, thus reducing the pull or load on the main chute cables. Screwed shackles were used in preference to hooks throughout the rigging.

Another feature of the spouting equipment is the plank walk and life lines attached to the arched braces along the chutes. The walk and life lines greatly facilitate work aloft on the chutes as well as being a safety-first feature. All the units of the spouting equipment are standardized and interchangeable. The entire spouting system is covered by letters-patent issued to the writer.

Auxiliary cables suspended parallel to the main chute-cables across the canon support the counterweighted trussed chute which is the pouring end of the last chute. These cables are also used to advantage to erect and strip forms on the dam.

The latest cost on concrete in place in the Don Pedro dam is a total of $6.50 per cu.yd., including a charge of $1.20 for overhead and plant.

The construction plant was designed by the writer, who was formerly assistant general superintendent of the project. R. V. Meikle is chief engineer, P. Jones, associate engineer, and R. C. Duncanson, general superintendent. A. J. Wiley is consulting engineer.

The Outlook for Road Building

-An Interview with H. Eltinge Breed, Consulting Highway Engineer, New York City

DATING from the recognition of the principle of federal aid, as embodied in the act of Congress of 1916, the nation's road-building activities received so tremendous an impetus that today funds are going into highway improvement, outside of city limits, at the rate of $2,000,000 a day. Year by year expenditures for road construction and maintenance have shown a steady increase. The government's supervisory agency in the federal-aid program—the U. S. Bureau of Public Roads—has enlarged its personnel of technical and administrative specialists and broadened the scope of its functions. The states, spurred on by the promise of federal participation in the cost of local work, have built up highway departments, headed by engineers, and throughout the country the trend has been toward the centralization of technical and financial control in these bodies, thus largely eliminating waste, incompetence, and even graver abuses incident to divided control by counties and lesser political subdivisions.

In step with these developments has occurred the expansion of industries engaged in the manufacture of equipment and materials for road construction, so that from the days, not so long ago, when highway work was largely a pick-and-shovel job the advance on the commercial side has swept into a period of specialized machinery, improved materials, and methods which have produced startling economies in time and labor.

Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, has estimated that $720,000,000 will be expended this year for highway construction and maintenance outside of cities, as compared with $600,000,000 in 1921, $500,000,000 in 1920, $389,000,000 in 1919 $286,000,000 in 1918, and $280,000,000 in 1917. These figures are significant especially when compared with the $60,000,000 total in 1904.

Peak Not Yet Reached—With all available evidence pointing to the fact that the road-building program is now running in high gear, the question arises as to whether the present pace can be maintained or increased and, if so, for how long? In other words, is the road-building curve near its peak and is a slump in activity within a few years probable, or, once the summit has been reached, will operations continue on a scale which will maintain the plotted line horizontal, denoting stability in the annual volume of work? It was on points such as these that H. Eltinge Breed, consulting highway engineer of New York City, and formerly first deputy commissioner of the New York State Highway Department, gave his views to *Engineering News-Record's* representative during a recent interview. In substance, he believes that for the next half dozen years there will be a progressive increase in the annual expenditures for highway improvement and that after that time and for many years to come there will be no falling off in amount of work done or money spent, but that activity will hold up at about the level reached when the curve ceases its present ascent and flattens out.

The Road Bond Market—To get at the reasons for this estimate of the situation, it is necessary to go back a year or two and consider the conditions which then surrounded the marketing of securities for highway improvement. With industrial stocks soaring to new high levels during the early part of the year 1920, with money rates abnormally high and business inflation in the final stages of its post-war rampage, highway bonds, even those carrying an interest rate of 5 per cent, were practically unmarketable at par. This condition had the effect of deferring highway improvements. Another factor which applied particularly to counties was the previous use of credit up to the legal debt limit, thus making unlawful the issuance of additional securities. Many counties, boroughs, and townships received in 1918 or later authorization for financing road-building programs with a certain definite sum available for covering a certain mileage of work. Due to various legal technicalities and the slow-moving routine of official channels many of the counties were not in a position actually to advertise contracts for the work contemplated until many months had elapsed and prices for labor and materials had risen to a point which made the cost of the proposed construction with the amount of money available prohibitive and the work, therefore, was postponed.

The foregoing combination of circumstances operated to delay work which should have been done and for which there was a popular demand as evidenced by the favorable results of bond issue elections. There had accumulated, therefore, a considerable volume of "frozen" highway improvement work which the present drop in prices of material and labor and the greatly improved market for bonds are thawing out. It is Mr. Breed's observation that 5-per cent highway bonds now find a ready market at par or better, and in several cases in the New England States it has not been necessary to look to outside sources for the disposal of the securities because local banks took the entire issues.

Many Influences Active—The first big influence favoring an expansion of road-building activity now is the strong position which states, counties and townships now find themselves in with respect to the sale of bonds, and the advisability of placing work under contract at present construction costs. Some deeper reason than the present status of highway financing, however, is needed to justify the prediction that road-building activity will continue on a large scale for many years. As Mr. Breed sees it, there have been at work a number of *cumulative* influences which are just now beginning to make their full force felt. At the head of these influences Mr. Breed places the federal-aid highway legislation which Congress has enacted and has now under consideration. The act of 1916, it will be recalled, appropriated a total sum of $75,000,000 for a five-year program of state highway construction and $10,000,000 for forest roads. There followed the 1919 amendment to the foregoing act appropriating $200,000,000 for a three-year program of state roads and $9,000,000 for forest roads. The most recent amendment, that of 1921, authorized $75,000,000 for a one-year program and $15,000,000 for forest roads Since 1916, therefore, the several federal appropriations for road-building purposes, exclusive of forest routes, have totaled $350,000,000 and as the availability of these sums was predicated upon the obligation of the states to raise equal amounts, a grand total of federal and state money of $700,000,000 for highway improvement is traceable directly to federal-aid legislation.

The federal-aid laws, however, have had an influence which reaches far beyond the raising of these specific

sums for road construction. They have been responsible for the development of state highway departments and the provision of adequate technical supervision over the work for which the money was spent. More than any other single factor, they were responsible for stimulating the public's interest in road construction particularly in view of the fact that the requirement of matching federal money with state funds made the issue one of direct local interest.

In 1915, prior to the Federal Aid Act, 70 per cent of the road work was done by agencies other than state highway departments, most of it by county officials. Such a system was bound to be wasteful. Overhead costs were high, engineers were not always employed, systems to serve the best interests of the state as a hole were not developed, and the opportunities for corruption were greater.

With the passage of the Federal Aid Act of 1916 and the insistence of the government upon the construction of federal-aid roads under the supervision of state departments, existing state highway departments were enlarged and strengthened, and in 17 states highway departments were created where previously there had been none or the existing one was not properly equipped to perform necessary functions. With efficient departments the work has been shifted to their hands until at the present time they supervise more than 60 per cent of the road work. This assures to the taxpayers the services of engineers trained in road work, a centralized authority responsible for the expenditure of funds and a far-sighted plan of development and financing.

It was natural that the activity in state highway improvement created by federal aid should be reflected in county, borough, and township work. With the federal government and the states setting them an example, the lower political sub-divisions, actuated in many cases by local pride, put into highway improvement money which, under other circumstances, it would have been difficult, if not impossible, to raise. Both directly and *indirectly*, therefore, the establishment of federal aid has built up in every state of the country an overwhelming sentiment in favor of good roads.

Other influences have also been at work. Automobile associations, both national and local, have been consistent good-roads supporters, while even more intensive educational work has been done by the organizations of automobile and motor-truck manufacturers. Added to these efforts has been the work of such trade associations as the Portland Cement Association, the Asphalt Association, and the National Paving Brick Manufacturers Association. Individual manufacturers of road-building machinery also have taken a prominent part in promotional work, while the technical associations have impressed upon the engineer the big place which highways occupy in the general engineering field. The good-roads doctrine also has been carried into the colleges and schools, and a great amount of educational work has been done by the Committee on Highway and Highway Transport Education.

With all these influences active, the public has been made to see so clearly the value of highway improvement and the present need for it that there has developed a nation-wide demand for the work to go forward on a large scale.

More Motor Vehicles—With 10,500,000 motor vehicles registered in the United States in 1921, equivalent to one motor vehicle for every ten people, Mr. Breed believes that with the present mileage and condition of highways in certain sections of the country the saturation point has about been reached. On the other hand, it is believed that the United States has not yet reached the peak of its motor-vehicle consumption powers, and with more automobiles and trucks in prospect the demand for more and better highways will be insistent. From this angle alone it would seem that there can be no letdown in the road program for a long time, and even after a decade or so, when our state highway systems have been developed, vast sums will have to be spent on reconstruction as well as maintenance. Once educated to the advantages of a hard-surface route, the public is sure to call for replacement, when necessary, of equally high, if not higher, types of construction.

In return for each dollar expended on them, good roads add a generous contribution to the national wealth, expressed not only in the cash accretion of realty values and marketing facilities, but also in the more intangible and vastly more potent increase in human happiness. This is the ultimate reason, surpassing all others, Mr. Breed believes, which makes people willing to contribute enormous sums for highway improvement. Good roads are a constructive achievement whose immediate benefits the most stupid can discern, while their social and economic values transcend the keenest imagination.

The future holds great possibilities for the further development of the motor truck as an agency of transport and to provide for this service roads of durable types will be in increasing demand. Mr. Breed makes the significant statement that today 80 per cent of our highways are inadequate for modern motor traffic. Among state highway officials with whom he has come in contact he finds a sentiment favoring a federal-aid program carrying appropriations of $100,000,000 a year for five years. With the states' share added, this would make available $1,000,000,000, exclusive of local funds which, in the active road-building states, far exceed the total involved in the federal-aid program.

No Slump Probable—On the assumption that such a program of federal aid should become effective, it is Mr. Breed's belief that the peak of road-building activities in the United States, measured by annual expenditures on construction and maintenance, will be reached in about six years. It does not follow that from this point on there will be any appreciable diminution in volume of work or funds expended, for by that time much reconstruction will be necessary and, with the increased traffic, many roads which even now are scarcely adequate will have to be widened, resurfaced and otherwise improved. It is pointed out that today the foundations under many roads with durable types of surfacing are only 5 or 6 in. thick, insufficient for heavy truck traffic. The future will call for a strengthening of such routes. Then, too, the public now refuses to accept the highway as a *seasonal* means of transport. It demands all-year-round traffic and this will mean, of course, the substitution of hard surfaced roads on adequate foundations where now the types are earth or gravel.

With this extensive program in prospect, Mr. Breed believes an increase in the personnel of our state highway departments must be made and high-grade experienced men secured *and held* in these organizations to insure the wise expenditure of the enormous amount

of money that will go into road work for a number of years. It is in the public interest to readjust salary schedules in almost all state highway organizations to make the work attractive to the right kind of men. Today the turnover is large because as good men are developed in the state organizations they are frequently offered more remunerative employment by commercial organizations in the highway field.

Taken as a whole, the evidence points clearly to the conclusion that highway improvement is now and for many years will continue to be one of the nation's great industries.

Cantilever Arms on Aqueduct Trestle Allow Unobstructed Stream Flow

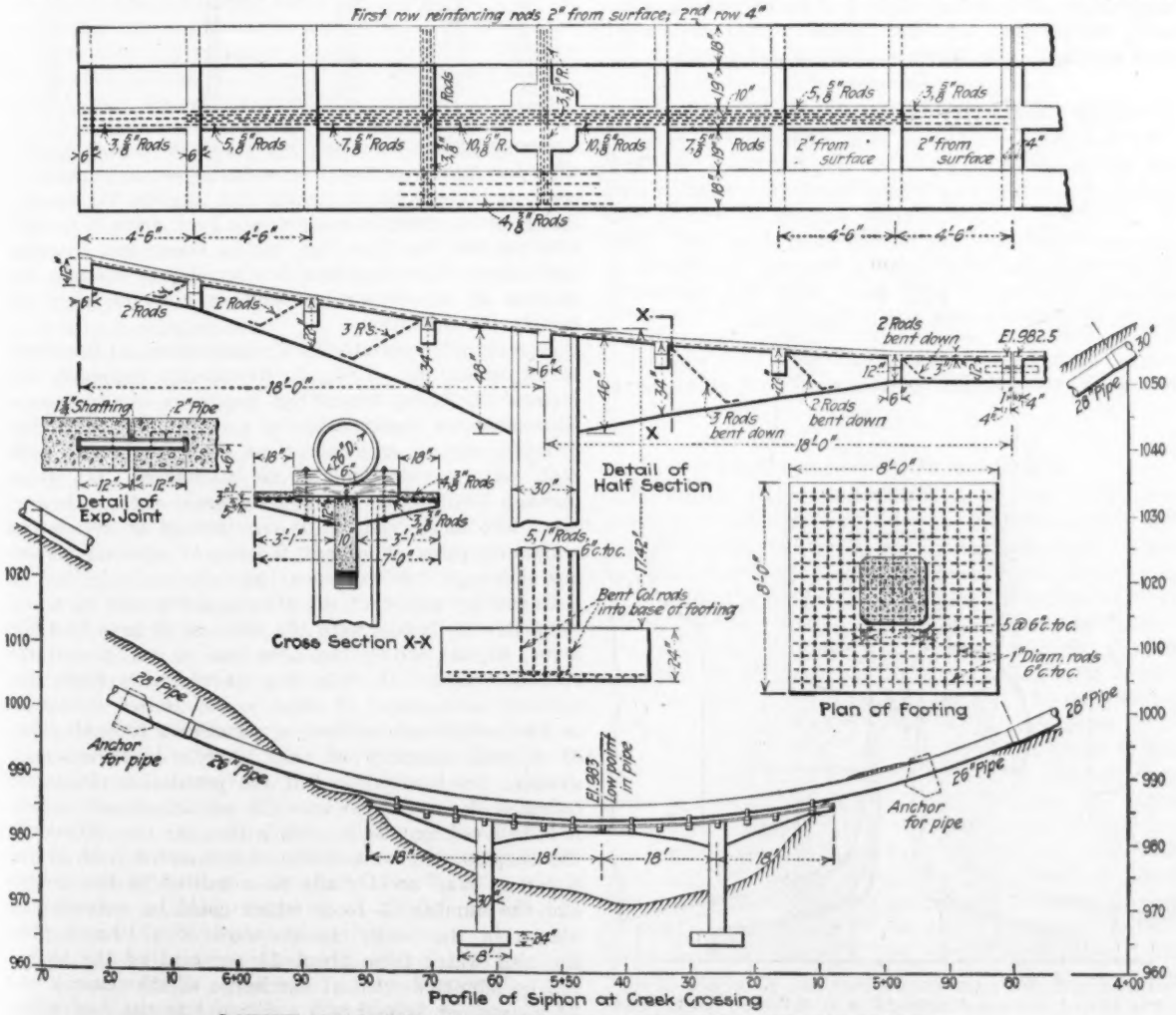
By R. A. Hill
Of Quinton, Code & Hill, Consulting Engineers, Los Angeles, Cal.

THE aqueduct which brings to Santa Barbara, Cal., water stored by the Gibraltar Dam on the Santa Ynez River, crosses as an inverted siphon the deep and narrow gorge of Mission Creek. At the stream crossing there was constructed a rather unique concrete trestle made up of balanced cantilevers, which supported the single wood-stave pipe line forming the siphon.

The steep sides of the canyon made it impracticable to carry the pipe beneath the bed of the stream on account of the sharp bend which would have resulted. At the time of construction the prices of structural steel were extremely high and the fire hazard made wood construction undesirable. Accordingly, it was largely a matter of determining the most economical type of concrete structure which would fit the existing conditions.

Mission Creek is a small stream which is normally dry during the summer months. Large flows often occur in the winter and pass down the canyon with extreme velocity attended by much scour and disturbance of the stream bed. Hence large openings with few obstructions had to be left for the passage of storm waters. It was also necessary that the volume of concrete be reduced to a minimum because all materials had to be packed down the side of the mountain on burros and mixed there by hand. The trestle which was built actually contained less than 30 cu.yd. of concrete for a span of 72 ft. of which the center 36 ft. presents no obstruction to the flow of Mission Creek.

Design of Cantilever Arms—The design was somewhat unique in that is consisted of four balanced cantilever arms 18 ft. in length, each pair being supported on a single column 30 in. square. As the minimum radius of 26 in. diameter wood-stave pipe does not greatly


First row reinforcing rods 2" from surface; 2nd row 4"
Detail of Exp. Joint
Detail of Half Section
Cross Section X-X
Plan of Footing
Profile of Siphon at Creek Crossing
Anchor for pipe
28" Pipe
El. 983 Low point in pipe
Bent Col. rods into base of footing
2 Rods bent down
3 Rods bent down
El. 982.5

LAYOUT AND SECTIONAL DETAILS OF CANTILEVER AQUEDUCT TRESTLE

exceed 150 ft. it was necessary to construct the trestle with the top of the cantilever following the curve of this radius with the lowest point of the curve at the joint in the center, midway between the two supports.

The wood-stave pipe was placed directly above the axis of the cantilever. The pipe was supported at 9-ft. intervals on timber cradles. These rested on brackets which extended out 3 ft. each side of the cantilevers themselves. The brackets, 4 ft. 6 in. apart, also served to carry a concrete walk along each side of the pipe. Each cantilever was 10 in. in thickness and varied in depth from 12 in. to 46 in. and was designed to have sufficient strength to carry the pipe should any other of the cantilever arms fail to assume its load.

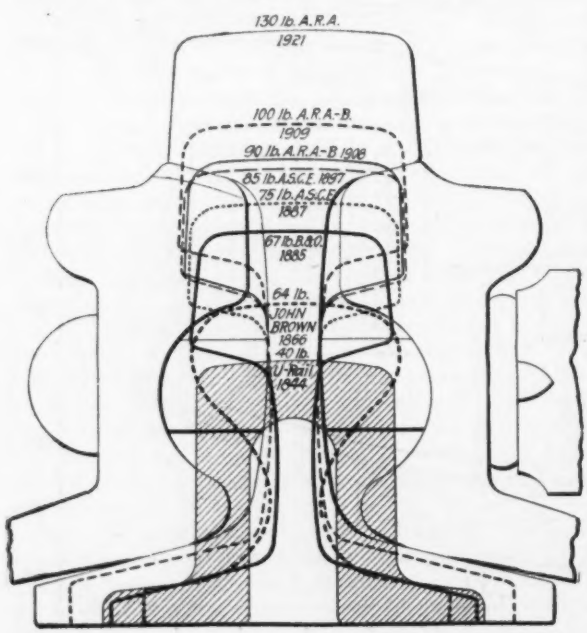
As stated above, each pair of cantilevers was supported by a single column 30 in. square designed to withstand the maximum bending moment which might come on it in any direction. These columns each rested on a simple slab footing 8 ft. square and 2 ft. thick placed at least 6 ft. below the bed of the stream.

An expansion joint 1 in. wide was inserted between the ends of the center cantilevers. The load from one cantilever to the other was carried across this expansion joint by means of a piece of 1¾-in. shafting 24 in. long, loosely fitted into 2-in. pipes set in each cantilever.

The trestle was designed and constructed under the supervision of Quinton, Code & Hill, consulting engineers, Los Angeles, who had charge of the development work on the City of Santa Barbara water supply.

Railroad History Written in Rail Sections

In describing the laying of the new 130-lb. rails on the Baltimore & Ohio R.R. the *Baltimore & Ohio Magazine* presents this interesting sketch which shows to a common scale the cross-sections of the several rails that have been used on that road since 1844. This sketch illustrates in a striking manner the efforts of railroad builders to keep pace with the increasing weight of motive power and rolling stock.



COMPARATIVE RAIL SECTIONS USED IN B. & O. R.R. The 40-lb. U-rail rolled by the B. & O. R.R. Co., and is said to have been the first rail rolled in the United States.

Limit of Roof Connections to Separate Sewage Systems

BY JOHN P. WENTWORTH

Assistant Engineer, Metcalf & Eddy, Consulting Engineers, Boston, Mass.

SUCCESS of a separate sewer system depends largely upon strict and careful administration. An important question for an engineer, in choosing between the separate and combined systems, is whether it is practicable to obtain such administration. The engineer should bear in mind that the separate system cannot be properly operated unless the city makes sufficient appropriations annually to employ competent engineering and plumbing inspectors. The community may provide an effective administration of the sewerage and drainage system for many years and yet during a lapse of a few years, connections may be wrongly made to such an extent as to render the system inadequate. After such connections have once been made it is with extreme difficulty that they can be traced and changed, particularly if a considerable time elapses between the making of the wrong connections and the effort to rectify the mistakes.

DATA FOR ESTIMATING MAXIMUM RATE OF FLOW IN SEPARATE SEWERS

Area of District, Acres	Max. Sewage Flow, Gal. per Acre per Day	Max. Allowance If Population Should Equal Flat Rate of 25 Persons Per Acre, Gal. per Cap. Daily	Number of Persons per Acre for which Provision Would Be Made on Basis of 300 Gal. per Cap. per Day	Number of Roofs which could be Connected with Sewers without Causing Surcharge Assuming a Uniform Pop. Density of 25 Persons Per Acre
10	21,900	875	73	one in 40
25	18,500	740	62	42
50	16,500	660	55	45
100	14,600	585	49	45
250	12,500	500	42	47
500	11,100	445	37	54
750	10,400	415	35	63
1,000	9,960	400	33	69
2,000	9,960	400	33	59
5,000	9,960	400	33	48

In a recent report to the Commissioners of Sewerage of Louisville, Ky., J. B. F. Breed, city engineer, and Metcalf & Eddy, consulting engineers, made certain allowances for storm water as a safeguard against the ultimate serious overcharge of separate sewers with roof water, which might be discharged into them through connections accidentally made with such sewers. The data relating to the method of estimating maximum rates of sewage flowing in separate sewers are shown in the accompanying table.

It will be seen that the allowance for rate of maximum flow decreases with the increase in area to 1,000 acres, beyond which the allowance is for a uniform rate per acre. In this way provision is made for unusual development of small areas, limited industrial or mercantile development, or admission through error of a small quantity of roof water. If there is no unusual development and if the population ultimately becomes 25 persons per acre the average density which it is believed may be reached within the next 40 years) the surplus will be available for carrying such storm water as may accidentally be admitted to the sewers and the number of roofs which could be connected is shown in the table. In the case of a 10-acre plot, the roof water from about 2½ per cent of the houses can be admitted without surcharge of the sewers. At 7½ houses per acre this is equivalent to the roof water

from about two houses. In the case of 1,000 acres, about 1½ per cent of the houses can be accommodated, which is equivalent to about 100 houses. The run-off from the roofs is estimated, by the rational method, using a 15-year frequency precipitation curve, a run-off coefficient of 0.8 and an average velocity of flow in the sewers, of 3 ft. per second.

It is very important to note that the allowance for storm water is only for connections accidentally made and the authors state this very clearly in the following paragraph:

> Wherever separate sewers are provided, it is absolutely necessary that roof and street water be rigidly excluded. If this policy is not strictly adhered to and such waters are discharged into the sewers, the system will certainly become overcharged and not only fail to function properly but will actually become a source of annoyance and damage, for which the city may be held liable. The allowance herein advised for roof water is provided solely for connections accidently made. Where any such connection comes to the knowledge of the city, it should forthwith be disconnected.

Hetch Hetchy Project Near Power Utilization Stage

RAPID PROGRESS has been made during the past year on the Hetch Hetchy project which is to store waters of the Tuolumne River in the Sierra Nevada mountains, about 150 miles east of San Francisco, and bring to that city a supply of 400 m.g.d. An increase in the yield rate on the bonds so that they could be sold more readily, the settlement of labor troubles by putting tunnel work on the open shop basis, and the effective organization of the work have all contributed to better progress. It is expected that water can be delivered by the end of 1923 through the 18.3-mile mountain-division tunnel. By that time the Moccasin Creek power plant, located at the lower end of the mountain division, and designed for a capacity of 70,000 hp. is to be ready for operation so that the water can immediately be utilized for power development.

The mountain division consists of a single conduit of full ultimate capacity. The portion of the aqueduct between Moccasin Creek and San Francisco, however, will be built in smaller units, probably three lines of steel pipe 7 ft. in diameter, each with a capacity of 133 m.g.d. These will not be constructed until it becomes necessary to supplement the Spring Valley sources and this work should be deferred as long as prudence will permit, City Engineer O'Shaughnessy says, in order to minimize the financial burden. Meantime, the demand for power has made it worth while to rush that part of the work on which the first unit of power development depends so that revenue from the sale of power may aid in meeting interest on the investment already made.

Concrete is now being poured in the Hetch Hetchy Dam at the rate of about 1,000 cu.yd. per day, and about one-third of the total 360,000 cu.yd. has been placed. The contract with the Utah Construction Co. calls for completion by Dec. 31, 1923. Although the ultimate height of the dam will be 430 ft., the present contract calls for building it to a height of 345 ft. only, which will develop a storage capacity of 206,000 acre-ft., or 60 per cent of the ultimate capacity.

The 18.3-mile tunnel which will convey the water to the Moccasin Creek power development is located in solid rock for its entire length. The tunnel is now being driven from ten headings by the Construction Company of North America under a cost-plus-fee contract. The best progress records were made at Priest Porta last August when the heading was advanced 776 ft. in 30 days. Of late the total progress at all ten headings for 30-day periods has been about 4,000 ft. The tunnel is designed to carry 619 sec.-ft. and where concrete lining is used has a horseshoe section 10½ ft. in diameter in the clear. A 6-in. concrete lining is to be placed in about half the length of the tunnel. At the lower end of the mountain division, and as a forebay for the Moccasin Creek plant, an earth and rock-fill dam, 145 ft. high, is being built to develop a storage capacity of 2,500 acre-ft.

Looking ahead to the time when Hetch Hetchy water can be delivered to San Francisco, the city has recently appropriated funds for the immediate construction of 23 miles of conduit on the San Francisco end of the aqueduct. This conduit is to carry 24 m.g.d. and until it is needed for Hetch Hetchy water is to be used by the Spring Valley Water Co., to bring a supply from Calaveras reservoir to supplement the present flow of 40 m.g.d. which is the maximum that can normally be delivered to the city through existing lines. The private company is expected to pay the city for the use of this new conduit an amount not to exceed $250,000 per year, which is to represent the interest on the investment. The Hetch Hetchy project is being carried out under the direction of M. M. O'Shaughnessy, city engineer, with N. A. Eckart as principal assistant.

According to the San Francisco *Municipal Record*, "all the more difficult portions of the work in the inaccessible mountains have been well started, and money may be spent now at the rate of $6,000,000 per year to complete the project. If this were done, water could be delivered to San Francisco inside of six years."

Among articles that have appeared in *Engineering News-Record* descriptive of the Hetch Hetchy project, some of recent date are as follows: Excavating Foundations of the Hetch Hetchy Dam, Aug. 11, 1921, p. 222; Tunnel Driving Progress, Nov. 17, 1921, p. 833; Cement Handling in Bulk on the Hetch Hetchy Dam, March 2, p. 352.

Portland Cement in the Orient

According to a recent bulletin issued by the Department of Commerce compiled from statistics and information contributed by the American trade commissioner in China, there are six portland cement plants operating in China at the present time. These are located at Tong Shan, Province of Chihli; Tayeh, Province of Huteh; Tsan Kan near Tsingtao, Province of Shantung; Canton, Province of Quwangtung; Kowloon, Hongkong Leased Territory; and Green Island at Macao. The daily capacities of these plants are as follows: Tong Shan, 3,000 bbl.; Tayeh, 400 bbl.; Tsan Kan, 570 bbl.; Green Island, 350 bbl.; and Kowloon 2,000 bbl. The average local price is between $6.50 and $7.50, Mexican, per barrel of 375 lb. During 1919 the production of portland cement in Japan had reached 6,500,000 bbl. per year, produced by twenty companies capitalized at about $22,000,000 and employing about 7,000 laborers. Cement in 1920 ranged around 17 yen ($8½) per barrel, but the price has now receded. The cost of production at the mill in 1920 was about 8 yen per barrel when cement was selling at 12 yen per barrel.

Tacoma Builds Semi-Circular Conduit of Gunite

Addition to Water-Supply Line for City in Washington Has Inverted Arch of Concrete Placed With Cement Gun With Precast Slab Top and Gunite Cover

LAST summer the city of Tacoma, Wash., through its water department, completed a built-in-place water pipe of novel section and detail which was especially novel in that concrete was placed by the cement gun. The line collects the discharge of wells, is 4,632 ft. long and under pressure of not more than 10 lb. per square inch. The gunite type was selected as the most economical after comparative estimates for steel and precast concrete.

A horseshoe cross-section was decided upon to facilitate the application of gunite, as it permits the nozzle-man to do all shooting from alongside of the ditch with the advantage of eliminating the inside forms. Two sections were designed, the smaller section measuring 24 in. and the larger section measuring 36 in. across underneath the top slab. The semi-circular part of the large section is made of gunite 3 in. thick designed as part of a cylinder and enlarged to 5 in. in thickness at the construction joints below the precast slab cover. Details are shown in the drawing. The precast cover was made of 1:3 cement mortar 1½ in. thick and reinforced as shown. These slabs were intended to carry only the weight of gunite during construction or the weight of a man temporarily while the top steel was being assembled and the top cover of gunite was being shot in place. Above the cover is a top slab of gunite 3 in. thick designed independent of the precast slab. A maximum backfill of 5 ft. was assumed and various heads up to 23 ft. were provided for in the reinforcement, water and backfill stresses being considered to act independently.

PART OF 36-IN. PIPE READY FOR GUNITE

No expansion joints are provided for and temperature stresses are taken care of by eleven ⅜-in. rounds, spaced equidistant around the periphery and lapped 15 in. at splices. All gunite used both in the small as well as in the large section was of 1:3 mix cement and sand, measured in loose volume. The maximum unit stress for gunite in the top slab of the two sections was limited to 900 lb. per square inch. The maximum unit stress for the wire mesh was fixed at 16,000 lb. per square inch. On account of the extra reinforcement around the corners the top and bottom sections were considered to act monolithically.

Weir boxes, lamp holes and manholes were also built of concrete placed with the cement gun.

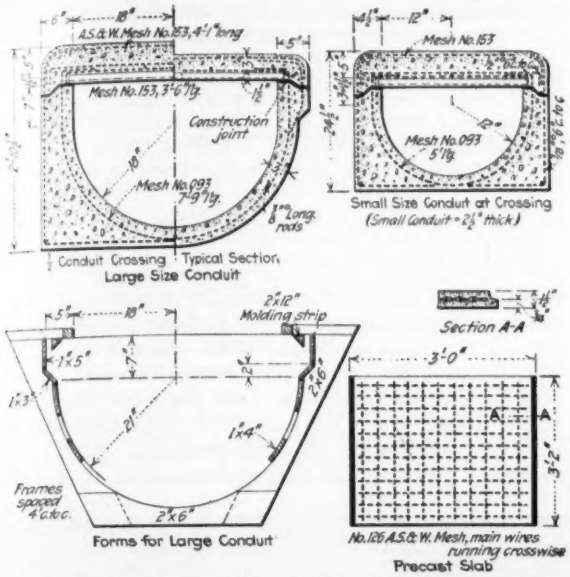
Details of the construction and tables of cost are given as follows by W. A. Kunigk, Superintendent of Water-Works of Tacoma.

Operating Outfit — The cement gun outfit for this work consisted of one N-1 and one N-2 cement gun. The mixing plant consisted of one sand-drier, one 4-cu.ft. gasoline concrete mixer and one rotating screen, all housed under a canvas roof. The cement guns were moved along as the pipe work was progressing. Usually about 400 ft. of pipe was built from one set-up of cement gun, limiting the length of the material hose to 200 ft. When construction work began the mixing plant was set up near the pump station and after about half of the pipe line had been built it was moved to a convenient place along the line about a thousand feet from the south end. In this manner all gunite material for the entire line was distributed from only two mixing stations.

A one-ton Ford truck took care of the hauling of this material to the cement guns, handling about one cubic yard per trip. The cutting and bending of the wire mesh was all done near the pump station using for the bending or straightening out a homemade roll consisting of three 6-in. diameter wooden rolls covered with old belting and supported on a wooden frame in the shape of an equilateral triangle. The upper roll was provided with a crank on one end and could be raised or lowered in a slot so that by passing the mesh between these three rolls it could be given the desired curvature required for the lower section of the gunite flumes or it could be straightened out as was necessary for the slab reinforcement of the upper sections. This device was found to be very simple and effective in taking care of the bending of all the wire mesh used.

All precast slabs were made in a temporary shed alongside of the pumping plant on flat forms which were piled on top of each other leaving about one inch of space between forms. This permitted the sprinkling of the slabs while they were curing and also provided for air circulation. The work was laid out and carried on with the idea of keeping as much of the old collecting system intact as was possible without seriously interfering with the progress of the new work. The maximum progress was limited to the output capacity of the two cement guns which the water department had available for this work. After the work had been gotten fully underway the various operations were carried on as follows:

Procedure of Operations — An excavation crew of 20 to 40 men made the excavation, trimming the ditch to the



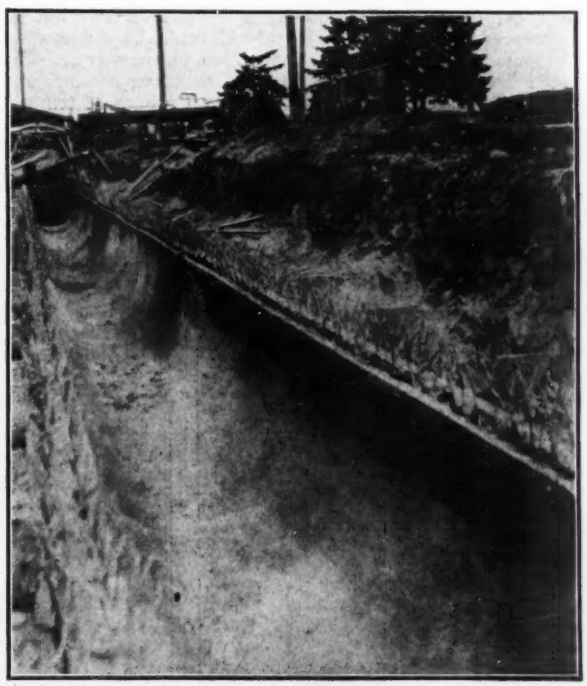
DETAILS OF THE TWO SIZES OF GUNITE CONDUIT

required grade and line and put in temporary street crossings at all street intersections. Then would follow a gang of from two to five men with a carpenter setting the forms in the ditch to grade. The forms consisted of girts spaced 4 ft. c. to c. sawed out of 2 x 6-in. lumber lined with 1 in. rough boards of a cheap grade conforming to the outside form of the lower section of the conduit. The girts were all cut at the sawmill according to templates furnished and the forms were assembled alongside the ditch in 12 or 16-ft. lengths. In setting the forms to grade and line in the ditch the lower quadrant of the circular section was left open, the backfill tamped to the required curvature and the sides then backfilled to the top of the forms. A crew of two or three men would then follow to place and wire the reinforcement for the circular section of the conduit. After the steel was assembled the wire mesh was raised the proper distance above the bottom of the forms and fastened with nails to the molding strips which formed the construction joints. Following came the cement gun crew consisting of one nozzleman, one helper assisting in moving of the material hose, one man with air hose, one cement gun operator, and one helper feeding the gun. For the shooting of the lower section the N-2 gun was used.

When starting on this work considerable difficulty developed in disposing of the rebounding sand which would accumulate in the bottom of the forms ahead of the gunite work and it was found difficult to remove from between the wire mesh reinforcement. The nozzleman would stand alongside of the ditch and shoot the side opposite him and when changing his position to the other side of the ditch to complete the half-circle he would find so much rebound accumulated that it was practically impossible to prevent sand pockets in the gunite. After some experimenting the following method was evolved. A ¾-in. air hose was connected to the main air pipe and fitted up at the end with a 4 ft. length of ¾-in. pipe hammered out at the discharge end to a flat nozzled tip. This air nozzle was operated by a laborer immediately ahead of the cement gun nozzle, always keeping the reinforcement clean and ready for the application of the gunite. (See view herewith). The sand accumulating was disposed of by blowing it into the space below the open part of the form where the ground had purposely been kept somewhat below grade. About every 10 to 15 ft. of conduit the cement gun nozzleman would operate his nozzle with air and water only, thoroughly cleaning and wetting the forms ahead and also leveling off the sand below the reinforcement. In order to shoot the inside as nearly as possible true to line the nozzleman's helper would carry a light wooden templet conforming to the inside outline of the conduit. With this he would keep a close check on the work as it was progressing, always pointing out to the nozzleman any slight variations in the gunite from the true line.

Finishing and Curing—Following the cement gun crew would be a cement finisher and his helper. In order that the finisher could work close to the nozzleman a canvas shield on a light wooden frame was always kept between the nozzle crew and the finishing crew. In this way the finisher was not bothered with flying sand which otherwise would have been troublesome on windy days. The finishing was done with a steel trowel after all surplus material had been removed with a straight edge by the helper. A very smooth surface was obtained in this way, equal in every respect to that of a precast pipe.

This surface was kept wet from four to six days and



COMPLETED INVERT OF 36-IN. SECTION

protected against the rays of the sun on bright days by portable canvas awnings mounted on 4 ft. x 12-ft. wooden frames. However, during the construction work considerable rainy weather was encountered which was conducive to producing a well-cured gunite. The cement gun crew and finishing crew would on such days work under canvas covers stretched over light portable wooden frames and practically no time was lost on this account except on a few days when the rain was accompanied by high winds. Next would come a small crew from two to four men removing the molding strips which formed the construction joints and the same crew would then proceed to lay the precast slabs. These slabs were laid with the troweled side downward in a 1:3 cement mortar and were also joined endwise with a mortar joint, striking off all joints on the inside of the conduit.

Following the crew placing the slabs came another small crew placing the reinforcement for the top slab. Then came the gunite crew shooting the top slab in place operating an N-1 gun, which has about 25 per cent less capacity than the N-2 gun which was used in shooting the bottom. In shooting the top, great care was exercised in thoroughly wetting the precast slabs and in making a perfect junction with the old gunite at the corners.

Finally came the finisher and his helper troweling off the top and taking proper care in protecting the green

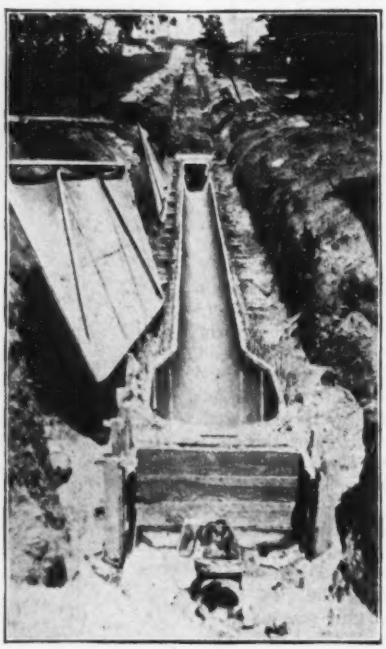
gunite. The distribution of all the material for the cement gun, the forms, the reinforcing steel, the precast slabs, etc., was handled by a one-ton truck. On days when it did not rain the green gunite was kept wet by sprinkling and after three or four days was covered with about 3 in. of the excavated material which was then kept wet for another four or five days.

In joining the gunite work of consecutive days no other precaution was taken except that of running the end of a day's gunite work out to a feather edge over a distance of about 12 in. The next morning the new work was joined after a thorough cleaning and wetting of the end of the preceding day's work and not the slightest leakage has appeared at any of these joints. A working test was made 28 days after the last gunite was shot and only a few small damp places could be detected at the construction joints immediately below the flat slabs. The water was left standing in the gunite pipe for a number of days but no appreciable lowering of water level could be detected in the standpipes and the conduit was then put in service. The conduit has now been in operation through one summer and one winter season and has withstood all ranges of temperature changes from 90 deg. to 10 deg. above zero without the slightest sign of distress on account of its continuity.

TABLE SHOWING ITEMIZED COST OF CONDUIT

Forms	36-in.	24-in.
Labor and material	$0.43	$0.43
Cement	1.12	.67
Sand	.50	.30
Reinforcement (material only)	.95	.58
Reinforcement (labor of cutting, bending and placing)	.34	.34
Gunite (labor of placing)	1.15	.66
Precast slabs (labor and material)	.79	.58
Depreciation of plant and cost of air, etc.	.09	.05
Cost per lin.ft. in place	5.37	3.61
Cost of excavation, reclaiming of old pipe, and backfilling	1.70	1.65
Total cost per lin.ft.	$7.07	$5.26

SLAB IN PLACE READY FOR GUNITE COVER



PART OF 24-IN. SECTION WITH MANHOLE BASE

MAN WITH AIR NOZZLE AHEAD OF CEMENT GUN

Cost Figures—The total cost of this construction work, $40,053.31, distributed over the different items, is shown in the following statements:

2,900 ft. of 36 in. conduit @ $5.37 per ft.	$15,573.00
1,732 ft. of 24 in. conduit @ $3.61 per ft.	6,252.52
Excavation, backfilling, reclaiming and dismantling of old wooden pipe and connections	7,892.80
13 weir boxes, 2 concrete weir box stands, 3 standpipes, 5 lamp holes, weir box connections, changes in reservoir connections, new air line connections for wells, blow-offs, railings, etc.	8,884.99
Engineering, testing and office expense	1,450.00
	$40,053.31

In analyzing the cost of the gunite work the cross-sectional area of the gunite in each conduit as built was approximately 10 per cent greater than the neat dimensions shown on the plan. The principal reason for this is the open section of the forms at the bottom and also a slight increase in the thickness of the top slab. In considering depreciation a plant investment of $4,400 was charged against this work for a period of three months on the basis of 3 per cent per month. This gives a total depreciation of $396. In this equipment were included the two cement guns with all the necessary material, air and water hose, one 4-cut.ft. gasoline mixer, one air-dryer, one sand-dryer, one rotating screen with gas engine, canvas and awnings, fittings and necessary piping. The cost of furnishing air for the cement gun on this work was very small on account of operating one of the electrically-driven compressors at the pump station. The station attendant operating the compressor was not charged to this work, and power was furnished by the municipal light and power plant at ½c. per kw.h.

Lessons of Construction—From close observation during the progress of the work, Mr. Kunigk draws the following conclusions:

The section of the conduit as built was very well adapted for doing effective gunite work, the nozzleman always working to good advantage regardless what part of the conduit he was working on. It is important in planning gunite work that the nozzleman can shoot at the surfaces as near as possible with the material nozzle in a position not less than 3 ft. away from the forms, pointing the nozzle at right angles to the surface. When, on account of obstructions the nozzleman is compelled to shoot at a surface at an angle considerably less than 90 deg. the result will be that the gunite will build up in riffles like a sandy

river bottom and will not be dense and uniform. An excessive amount of rebound will also result from this cause. It is also desirable to have, if possible, only one layer of reinforcement in a gunite section. This will tend to keep the rebound down to a minimum. For reinforcement wire mesh is preferable to bars. If bars must be used then the bars should be round. Square bars have a tendency to produce a small triangular area of rebound material back of the bars which contains practically no cement at all.

A larger section of conduit could be built at considerably less cost per cubic yard of gunite in place because there would be less loss in time in moving equipment along the ditch and a smaller proportion of loss of material, and also less expense in finishing. The principal advantage in constructing the conduit section as designed was that all crews could work simultaneously without interfering with each other, and that there was no delay on account of removing inside forms which is one of the troublesome features attending the building of a continuous concrete pipe or small cross-sectional area. For obvious reasons this type of conduit would not be economical for heavy pressures, for which condition a circular section should be adopted.

The best results in guniting were always obtained when the material hose was 100 ft. or less in length; 250 ft. was the maximum length of hose used on the job. Air pressure should preferably be not less than 35 lb. per square inch at the gun and water pressure should be greater than the air pressure by at least 10 lb. per square inch. The mistake is often made in gunite work in using sand that is absolutely dry. The writer finds that the best results can be obtained when sand retains from 5 to 7 per cent moisture. The tendency to dust at the nozzle will then be eliminated and the material will not separate even in a long line of hose. The air, however, must be delivered dry to the gun. It would be an expensive experiment to try and operate a cement gun on a damp or rainy day without an air dryer. The result would be numerous shutdowns on account of clogging of the gun or hose, or both. [Sand and air dryers used on the work will be described in a later Job and Office section of this journal.]

The method of constructing gunite pipe as developed on this work is not patented, and it is stated that there is no intention of taking out a patent thereon. The work was designed and constructed by force account under the personal supervision of W. A. Kunigk, Superintendent of Water Works, with O. A. Abelson as designing engineer and J. A. Kuehl and R. Bergerson as constructing engineers.

How Rochester Engineers Have Solved Problems of Making Luncheon Meetings Interesting

Current Events Capitalized in Preparing Program—Local Speakers Developed—Joint Sessions with Other Bodies—Many Novelties Introduced

By Waldo G. Wildes

Chairman, Luncheon Committee, Rochester (N. Y.) Engineering Society

THE weekly luncheons which, for a decade, have been held by the Rochester (N. Y.) Engineering Society have become an important feature of its work and rank with those of the leading lunch clubs of the city. Gradually developing from a small informal gathering without any speakers, they have gained impetus until, in the last year, an excellent choice and a timeliness of subjects and men, as well as several novel expedients, have given them their present standing. In topics of public interest having an engineering phase they excel, but they are never technical and they are often broad in their appeal, with the double object of stimulating enlarged sympathies and activities among the members and of attracting the progressive men of the community whose interests interlock with engineering. They are designed to balance the more technical monthly evening meetings and the still more highly specialized group meetings also conducted by this organization.

Speakers and Subjects—As funds for securing speakers at the luncheons have never been made available, it has been necessary to depend almost entirely on the courtesy of local speakers. Last year, however, inquiries were sent out to several engineers asking if they were likely to be in the vicinity of Rochester in the course of the season, with the result that a number of prominent out-of-town engineers were secured as speakers at the luncheons, virtually without expense to the society. However, it was necessary to depend mainly on home talent and the surprise was general that there should be so many unfathomed resources in the community.

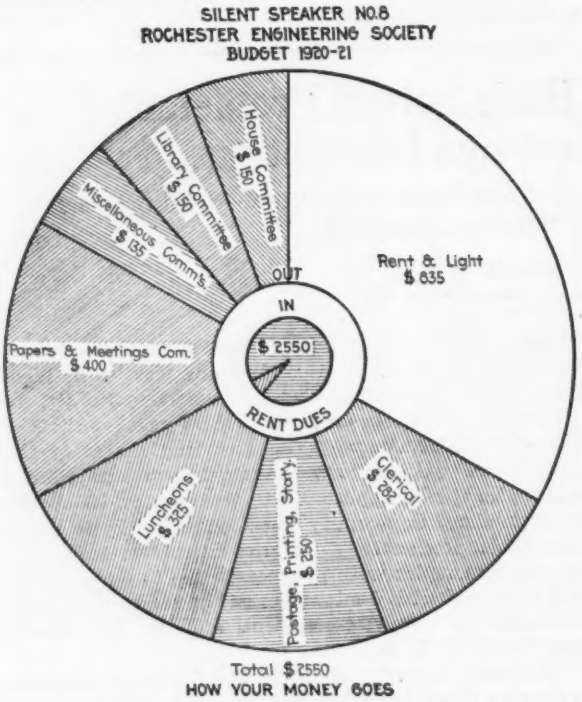
Making Home Talent Appeal—Ways were found to link these speakers into continuous programs. The "Rochester Live-Wire Series" was a caption adopted with this end in view. City planning was "Live Wire No. 1"; the Community Chest, "Live Wire No. 2; the University of Rochester, "5 Live Wires in 1"; the Chamber of Commerce, "The Last and Livest of the Live Wires." Speakers were invited to give their talks and topics special application to our group. Hence the subject of the Community Chest became "Social Engineering in Rochester." To give attractive force two appropriate topics were grouped in the "junior series" and combined with 5-min. talks on the junior engineers, organized by our vice-president, and the Boy Scouts and the Y. M. C. A.

Similarly, in order to make the luncheon meetings a clearing house for public matters relating to engineering an attempt was made to secure exhibits of important plans in progress—a local architect's conception of a central library building, for example, in conjunction with an address on our public library, or the unpublished studies for a proposed bridge over the Genesee River gorge, on another occasion. Sometimes, with similar intent, a brief, timely report was introduced—for example, from a local member of the American Engineering Council on the first meeting of that body. Considerable study was given to the presentation of the all-absorbing industrial problem, and where controversial discussions had arisen an effort was made to present the other side of the case later. To give further point and punch, the occasion of a speaker from the Chamber of Commerce, for instance, was advertised as Chamber of Commerce Day, drawings for the extension of the chamber building were exhibited and representatives of the chamber invited to attend.

Indeed, it was a rare occasion when some citizens known to be particularly interested in a topic were not extended an invitation to be present.

Joint Meetings—Carrying this principle further, invitations were extended to several local engineering organizations to meet with us on occasions of an appropriate address; the American Legion Engineer Post participated on Feb. 14, 1921, in a talk on "Americanization"; the local section of the A.I.E.E., was asked to put on a program of its own and furnished for the occasion an actual demonstration in wireless telephony. These meetings promoted attendance and co-operative spirit among the various professional groups.

Going still further afield, two joint meetings to consider arguments for and against the proposed St. Lawrence waterway were arranged with the Chamber of Commerce and drew an audience of more than 600 apiece. For another joint luncheon with the Rotary Club the speaker was furnished by the engineering society; and at still another time, the invitation to the secretary of the N. Y. State Builders' Association, then



ONE OF THE "SILENT SPEAKERS," SHOWING BUDGET

in convention in the city, to address the meeting, combined courtesy and expediency. Similarly, advantage was taken of speakers from particular colleges to invite the alumni on "University of Rochester Day" and "M. I. T. Day" and on all such occasions some little distinctive touch was added by decorating with the colors and, perhaps, marking the places at the table by small flags, as when the students training locally under the Federal Board for Vocational Instruction of Disabled Soldiers were luncheon guests by virtue of a special collection taken at a previous meeting. On occasion, also, appropriate songs gave character and contributed to the sociability.

Sociability—Aside from these expedients and the personal efforts of the leaders, there was instituted, to complete the breakdown of clannishness, a "Socialist" propaganda—a group of men being assigned red badges with the "Socialist" pledge (of sociability) upon it, and commissioned, each of them, to preside over one table and propagate the doctrines of the "Order of the Red Tag", passing the badge and responsibilities to another group after two weeks, and so on. This furnished mystery and amusement, with some telling effects on sociability, but fell to pieces prematurely through the enforced absence of the committee member in charge as "Chief Socialist."

"Silent Speakers"—At each of the first nine meetings a chart, especially prepared, was hung upon a frame on the wall behind the speakers table. Its object was not only to provide a novelty, but also to emphasize the topic or drive home some principle or information with economy of time and intensity of effect. These charts were called "Silent Speakers" and numbered 1, 2, 3, etc. They were executed, in general, gratuitously by various members from rough outlines furnished them. The first of these gave the membership statistics of the engineering organizations of the city. Another, in connection with the topic of the "Public Library," represented, in pyramidal form, the subdivisions of the society library. When co-operative industrial education was under consideration, the corresponding chart depicted Industry (embodied in a drawing of the Eastman Kodak buildings) linked to the University (a local university building) by the Rochester Engineering Society, which occupied the intermediate link, with the query underneath, "Why Not?" The distribution of the finances of the society was graphically portrayed in another and a cartoon on an unfortunate but amusing episode of an excursion of the society furnished material for the concluding chart—the artist being awarded a first prize on Ladies' Day and all the charts assembled for wall decoration. At the concluding luncheon of the season, also, a cartoon of the "Never Silent Speaker" was introduced by the president of the society as a surprise compliment to the committee.

Instead of reading the formal report of the chairman at the annual meeting of the society, lantern slides of the best "Silent Speakers" and of a few statistics were shown. Indeed, lantern slides prepared by members of our group were several times used to assist a busy and impromptu speaker in presenting his subject in a forceful manner. In one instance the "Silent Speaker" was introduced on the screen by word and sketch as the presiding officer and in turn introduced the real speaker of the day.

The "News Nugget"—It has been the custom to mail to each of the members postcard notices of the meetings. The colored 4 x 6-in. cardboard (varying in color from week to week) was last year given a form more flexible and piquant than the curt statement of speaker and subject. Out of it was gradually evolved the form of a miniature newspaper of three columns, ultimately 4½ x 6 in. in size and entitled *"Enjo-Luncher's Weekly"* and, beneath, in smaller type "News Nugget." The left-hand column contained, under the headlines, graduated when possible to simulate or mimic the dailies, an announcement of speaker and topic, with a compact statement of the appealing features of both. The last column ordinarily carried an appeal from a different angle and in lighter vein, an improvised verse or maxim, some timely excerpt from the sage remarks of Mr. Loyal Enjo-Luncher or an "Extra" in bold headlines. "Per-

sonals," with pleasant drollery intermingled, have appeared and often notices of other departments of the society, but whatever and wherever these might be, the law of the quill was decency, pungency and force.

The insertion of a mock advertisement and the impulse due to an overstrained exchequer led to setting apart the entire middle column and the foot of the other two to about eight ½-in. advertisements—the "Business Directory," it was called—obtained, first, altogether from members, but, later in part from outsiders. Subsequently, the card was enlarged to carry three more advertisements or other matter if desired, and sometimes a much longer card was used for additional notices or for carrying detachable reply card. The standard 11-ad. card cost $14.50 to print and mail and brought in about $22.00 in advertising, so that the luncheons were a welcome source of revenue.

From the printer's supply of cuts, one or more was always selected and often the text was adapted to fit the cut rather than *vice versa*. A play on words was sometimes employed to catch the eye. Using cuts for underscored words, the following are examples: *Bear* in mind; A *Pile* of Thanks; *Can you* come? The cuts added, thus, little to the cost, but much to the attractiveness as used in this and other ways. Opposite the marginal rectangle containing the name of the society was a duplicate which served to blazon a motto or inscribe the words, "Patriotic Number," "Travel Number" or to make an appeal, "Safety 1'st, Reply at 1 ce," or to recite the latest figures for the circulation or announce the peak of the attendance for the season.

CARTOON TRIBUTE TO LUNCHEON COMMITTEE

Another lunch club has already done the society the honor of imitating the form of card, both as to advertisements and as to detailed typography; and *Engineering News-Record* (March 31, 1921, p. 571) has also reproduced one of the issues in its columns.

Newspaper Publicity—Besides the publicity from the weekly cards and the notices in the monthly *Bulletin* of the society, it has been the practice this year to invite as guests reporters from the two morning newspapers of the city and a large amount of space has been thereby allotted. Several of the plans of proposed public works and one of the cartoons exhibited have been reproduced in the news columns and, besides the advance notices, full-page reports of the luncheon addresses have frequently appeared, all duly credited to the society. Even the editors have stooped to recognize the society several times in their editorials, which it had the honor of inspiring.

Essential Details—In regard to certain practical details it may be submitted that promptness of service, permitting the chairman to call the meeting to order about 12:45, after an announced luncheon hour of 12:15, is important. The chairman of the meeting, who is the chairman of the committee, except as he affords the audience the variety of other leadership from time to time, may well consume 10 minutes in announcements and in carefully planned remarks designed to give a certain continuity and purpose as well as sociability and esprit. Any "extra" feature will consume 5 min., leaving the principal speaker on the program a half hour to 1:30, to be followed by questions closing at 1:45 or preferably earlier. To delay beyond that hour would grievously threaten the attendance by consuming more time than many of the men are properly able to spare.

A suitable meeting room, detached from outside confusion, centrally located in a hotel or club of first quality is also found to be a pre-requisite and it is deemed expedient to hold the meetings through from warm weather to warm weather, so long as the superior quality of the program can be maintained.

Results—Throughout this program, the aim has been to capitalize the moments of relaxation for growth and service—to dissipate the conventional narrowness and professional non-solidarity of engineers. The attendance, which in the aggregate averages over 100, doubled last year. The discussions, the enthusiasm and a universal spirit of co-operation seem to indicate that, even if there have not been many tangible accomplishments, the effort is appreciated and is having the desired effect.

Net Section of Riveted Tension Members

A new discussion of the methods of calculation applicable to tension members with staggered rivet holes is given in Bulletin No. 2 of the University of Toronto by Prof. C. R. Young. He derives the exact formula for the deduction of area to be made from a diagonal section through two rivet holes, when the compound stress existing on the diagonal section (direct tension combined with shear) is taken into account in terms of the maximum resultant stress. The formula resulting gives the deduction as a fraction x of one rivet hole as follows, where g is the gage (transverse spacing), s is the stagger or pitch (longitudinal spacing) and h is the rivet-hole diameter:

$$x = \frac{g}{h} - \frac{2\,(g^3 + s^3 - h\sqrt{g^3 + s^3})}{h\,(g + \sqrt{g^3 + 4s^3})}$$

Comparing the results obtained from this formula with various rules for rivet-hole deductions that have been advanced in the past (see in particular V. H. Cochrane, *Engineering News*, April 23, 1908; T. A. Smith, May 6, 1915; and D. B. Steinman, *Engineering News-Record*, June 14, 1917), Professor Young finds the rules to depart pretty widely from the actual results for various cases. The proper deduction increases with increasing size of rivets and with decreasing gage. Of the simple rules, Professor Young finds best the second of two rules proposed by Steinman (see third reference above), which provides that a second hole is to be deducted if the stagger does not exceed one-half the gage, but is not to be deducted if the stagger equals or exceeds the gage, while for intermediate values the fraction of the hole to be deducted is intermediate, being $2(g - s)/g$. A closer adjustment to the usual conditions is obtained through a new rule proposed by Professor Young, which makes the deduction $x = 1.50 - 1.25sg$. For important cases and complicated arrangement of holes, the exact formula should be used; diagrams given in the original paper, for several rivet sizes, facilitate its application.

Water-Works Field Surveyed from Many Viewpoints

Abstracts of Four Papers Read Before the Annual Convention of the American Water Works Association, Held in Philadelphia May 15-19

Experiences with Light Cast-Iron Pipe

BY C. E. INMAN
Commissioner and Superintendent of Waterworks, Warren, Ohio

THIRTY-EIGHT years' experience under water-works contractors who employed able engineers and further experience as superintendent of water-works in a number of widely separated cities, during which I have seen laid much cast-iron pipe lighter than is demanded by the standard specifications in use for some years past, combined with the satisfactory experiences given by that pipe and by much other light pipe of which I have learned by correspondence or otherwise, leads me to advocate the more general use of the lighter weights than are now current. In each town and city observed, the pipe was tested under 150 lb. pressure after it was laid. In one city, the pressure is run up daily, at noon, to 120-lb. pressure. In this and a number of other cities there has occurred, so far as my information goes, only one failure of the light weight pipe.

As far back as 1887, the late George A. Ellis published a statement in which he gave the general verdict of engineers, after long discussion and experiment, against using 40-lb.-per ft. 6-in. pipe when 28-lb. pipe will serve the purpose with equal safety.

If Classes A, B, C and D pipe, of less than 20-in. diameter, all poured from the same mix and melt, are foundry tested under 300-lb. pressure, why advise A for 43 lb., B for 86 lb., C for 130 lb. and D for 173 lb. per square inch?

Discussion: J. N. Chester, Pittsburgh, Pa., said that when, years ago, he became connected with the American Water Works & Guarantee Co., it was laying 100 miles of pipe yearly, of which 80 per cent was 6-in. weighing only 30 lb. per foot. He became a convert to that practice. Those who fixed the standard higher, although well intentioned, have loaded the country with many tons of unnecessary pipe weight. William F. Wilcox, Ensley, Ala., said that for many years past 30-lb. weights have been used for 6-in. pipe in the south. Leonard Metcalf, Boston, Mass., remarked that much light-weight pipe has been used in New England.

* * *

Some Observations on Wood Pipe

BY J. W. LEDOUX
Consulting Engineer, Philadelphia, Pa.

FOR all ordinary sizes of pipe it is generally recognized that the present standard is cast-iron pipe. For water purposes there is more cast-iron pipe used than all other pipes combined, the reason being that cast-iron pipe can be made absolutely tight under all circumstances and will remain so under all variations of pressure. For very large sizes, however, it is too costly as compared with wood or steel, and under many situations the reduction in capacity due to tuberculation is so serious that engineers will prefer a reinforced-concrete pipe or wood pipe.

Undoubtedly in regard to extensive use, wood pipe comes next to cast iron. It may be conservatively stated that cast-iron pipe will last one hundred years. Although there are many modern wood pipes that have been giving good service longer than 25 years, when we compare wood with cast iron it is best to assume a short life for the wood pipe.

Comparative Cost of Wood and Cast-Iron Pipe — As an example, let us take 24-in. continuous redwood pipe and assume a life of 25 years. Say the wood pipe will have to be renewed four times in 100 years and cast-iron pipe will last indefinitely. Let us take the average discharging capacity for the wood pipe as 20 per cent greater than that of cast iron. Table I shows the details and result of a cost comparison, computed on the basis of present worth. [Table II, showing various comparative data on the cost of wood and cast-iron pipe is also reprinted here. The original paper contains many data on wood pipe design, both as to banding and hydraulic calculations.—EDITOR.]

For machine-banded eastern pine (also 24 in.) the initial cost would be $28,900 as against $41,900, but after making the same calculations as are shown in Table I the present worth figures obtained for wood pipe would be $50,125 and for cast-iron pipe $86,650, a saving of $36,525.

TABLE I—SAVING BY USING WOOD RATHER THAN CAST-IRON PIPE

	Wood	Cast Iron
Initial cost of 24-in. pipe	$41,900	$67,600
Increase in cost of cast-iron pipe to obtain 20% increased capacity	.....	6,450
Initial cost for equal average capacity	$41,900	$74,050
Annual Charges:		
Wood pipe—repairs 1%, taxes 0.6%	$670	....
Cast-iron pipe, repairs 0.25%, taxes .6%	....	630
Present worth of $41,900 at 5% for renewal in 25 years	$12,373	.....
Present worth of $41,900 at 5% for renewal again in 50 years	3,654	.....
Present worth of $41,900 at 5% for renewal again in 75 years	1,079	.....
Present worth of $41,900 at 5% for renewal again in 100 years	319	.....
Present worth of $670 per year for 100 years at 5%	13,400	.....
Present worth of $630 per year for 100 years at 5%	.....	12,600
Initial cost for equal average capacity	41,900	74,050
Total present worths	$72,725	$86,650
Saving (about 20%)	14,488	.....

TABLE II—COMPARATIVE COST PER FOOT INSTALLED OF WOOD AND CAST-IRON PIPE FOR 65-LB. PRESSURE

Nominal Diameter In.	Machine-Banded Wood Pipe Pine	Redwood	Fir	Continuous Wood Pipe Redwood	Fir	Cast-Iron Pipe at $44 Per Ton
6	$0.96	....	....	....	....	$1.26
12	1.49	....	....	....	....	2.69
20	2.29	3.70	3.27	3.43	2.92	5.21
24	2.89	4.84	4.31	4.19	3.58	6.71
30	4.13	....	....	5.27	....	9.13
36	....	....	....	6.35	....	12.02
48	....	....	....	9.50	....	18.90

Trenching is for all kinds of pipe taken as follows:

6-In.	12-In.	20-In.	24-In.	30-In.	36-In.	48-In.
$0.37	0.52	0.76	1.00	1.15	1.40	2.00

The following weights of pipe are taken in pounds per lineal feet:

	6-In.	12-In.	20-In.	24-In.	30-In.	36-In.	48-In.
Machine banded pine	15	22	38	49	85	....	....
Machine banded fir	..	..	37	40	....	....	....
Continuous redwood	.	..	35	44	60	76	115
Continuous fir	..	..	38	48	66	83	125
Cast iron	31	76	160	210	300	407	660

Hauling taken at $2 per Ton.

For 12-in. machine-banded eastern pine pipe the initial cost would be $14,900 for the wood pipe and $26,900 for the cast-iron pipe, making the same calculations as before, the present worth of the total cost of the wood pipe would be $25,847, and of the cast-iron pipe $34,027, or a saving of $8,180, 28 per cent of the initial cost of the cast-iron pipe.

Why Is Cast-Iron Pipe Generally Preferred?—When a financial comparison on a rational basis shows such a material advantage of wood over cast-iron pipe, the question naturally arises, why is cast iron so universally preferred by most of the leading engineers? It is, no doubt, because there have been so many unfortunate experiences with wood pipe.

From our knowledge of water pipe, it may be said that the best pipe that could be obtained for any purpose would be cast iron with some sort of non-corrosive and indestructible inner lining, but in ten years from now, this statement may be obsolete, and the writer is of the opinion that we are on the eve of great and fundamental improvements in water pipe manufacture. However, it is believed that it is believed that it will be many a decade before the use of wood pipe will be unwarranted. At present it is in use

by at least 500 municipalities and water companies scattered throughout the United States.

Discussion: J. E. Gibson, Charleston, S. C., said he did not think Mr. Ledoux had taken into account the cost of digging up improved pavements for the replacement of wood pipe, which would eat up the savings effected by the use of wood. Charleston has a large mileage of continuous wood stave pipe and some machine banded wood. It is going to lay five miles of 6 to 16-in. cement-lined cast-iron pipe. The reduction in diameter caused by the lining will be nothing like that due to tuberculation which soon comes back after cast-iron pipe is cleaned. John Cheater, Pittsburgh, Pa., said it is now impossible to get white pine suitable for wood pipe and that he would not want to use spruce. He was against using wood pipe in distribution system. He did not like to see wood put under pavement.

* * *

Present-Day Tars for Pipe Coatings

By W. R. Conard
Inspecting Engineer, Burlington, N. J.

When Doctor Angus Smith got out his process for coating cast-iron pipe, coal tar was a residue of the manufacture of gas from coal, just as it is today, only in those days the many by-products to be obtained from this residue were apparently little known, and the tar was what is termed "virgin tar". Could the good Doctor have forseen some things, such as by-products, tar from oil and water gas sets, etc., it is probable that he would have given much more detailed specifications, and placed many safeguards around the coating.

The present standard specifications follow somewhat the Smith specifications, but although they call for coal tar pitch varnish the material actually used is not pitch nor is it varnish as those terms are generally understood. Moreover, the kind or kinds of oil to be used "to keep the mixture at the proper consistency" and the proportions are not definitely stated, nor is needed provision made for variations in season and weather.

Composition of Tar—Average coal tar is made up of carbons, oils, acids and gases. The acids and gases are in the forms of hydrogen, oxygen, nitrogen and sulphur. Its main body is carbon and it is the carbon held together by the oils which protects the metal from corrosion, and it is the acids that tend to attack and corrode. Therefore, it is desirable to get for pipe coatings a tar as free from acids as may be, and as high in carbon and oils, especially the heavier oils, and to use the coating at temperatures that will not evaporate the oils.

Coal tar and its by-products are put to a wide variety of uses. The heavier material usually called tar (no matter how much it has been distilled or refined) is used for paving, road work, the various forms of roofing materials, etc., while the lighter part is used in many lines of industry, particularly the chemical, so that the value of coal tar is greater for refining purposes than in its crude state, which condition is the best for pipe coating purposes. The result is that unless the pipe maker controls some source of production, he has to compete with the refiner, with the consequence that there are times when he gets left, and the pipe purchaser is the innocent sufferer.

While the pipe maker specifies and tries to get virgin tar, I believe that the tar he does get does not contain as large a proportion of the heavy mineral oils as the tars of Angus Smith's time contained, so there are cases where the coating is not as durable as it once was. It seems possible that even using coal tars that have had their by-products extracted together with some other material or materials, whether oils or some other form of binder, that a better and more durable coating than at present can be found. I would not say to disregard tar entirely for as I view it there has not yet been found anything that could within economic limits take its place, but I do not think that the virgin tar of today is the last word in pipe coatings, and I do not think thorough research would develop some other material to put with tar that would form a much better protection to iron and steel pipe surfaces than we are now using.

Coating Not Impervious—From what I have observed of pipe which have been in service, it is my conclusion that the coating on the pipe is not impervious to moisture, having small pores which usually extend through the coating. This allows the moisture to get to the metal, whereupon ferrous oxide forms, comes out through these pores and spreads over the interior of the pipe. There is need to see whether there is something to use with the tar that will seal the pores. Also, I believe that investigation should be made of whether pipe of different sizes and classes should be dipped in the tar bath at different temperatures, for the volume of the metal in the pipe controls the number of heat units to be thrown off before the coating sets, and as long as the heat prevents the setting of the coating, the heat will also continue to evaporate the oils in the tar and tend to leave nothing but dead pitch.

As to what materials might be used in conjunction with tar to prevent the forming of iron oxide, these things have occurred to me. One is the coating, especially of the interior of the pipe, with some parrafin substance before applying the tar; this was suggested casually by S. B. Brown of Warren Foundry. The other is the use of some substance that has no oil- or gas-forming constituent, but is very dense and, when set, impervious to moisture, which will become fluid at approximately the same temperature as tar, and will mix with tar readily, and can therefore be put in the tar tank, and applied in conjunction with the tar. And still another might be to find some means of getting a much thicker coating on the pipe, which would stay put, and not tend to scale in cold weather, and soften and run in hot weather.

* * *

Fire Prevention and Fire Protection in Relation to Water Supply

By Frank C. Jordan
Secretary, Indianapolis Water Co., Indianapolis, Ind.

Regardless of insurance, when a fire occurs everybody loses. American fire losses are about $5 per capita, European countries show losses of only $0.11 to $0.60. Over 80 per cent of fire losses in America are preventable. The causes of these great losses in this country should be studied and a preventive campaign should be marked out, the latter to include legislation entailing personal liability for preventable losses. In many countries, the man in whose building a fire occurs must prove he was not responsible for the fire or forfeit his insurance.

A high fire loss in a city raises a question as to the integrity of the water-works just the same as a high typhoid fever rate raises a question as to the quality of the water supply, and therefore the water authorities should aim to cut down fire losses. In Indianapolis we have a fire prevention committee of 3,500 members, with representatives from every part of the city. The city is backing the work. The schools are used in the campaign.

The fire loss curve in Indianapolis had been going up steadily for years, as is true in other cities. In the year 1921 the Indianapolis firel oss decreased 36 per cent compared with 1920.

The committee has secured an agreement from roofers to charge reasonable prices for putting on fire-resisting roof coverings and to adopt a one-dollar-down deferred payment plan.

Discussion: Allen Hazen said that the city of Havana, Cuba, is almost free from fires. The water distribution is not laid out for fire protection. There is only one fire house in the city and that was built during the period of American occupation. Mr. Hazen thought that after shingle roofs, wooden floors would be the next thing to go in the interest of fire protection. Leonard Metcalf spoke appreciatively of Mr. Jordan's work in Indianapolis and added that it could well be duplicated by many members in their own cities. Dow R. Gwinn, Terre Haute, Ind., said that the people of Indianapolis and of Indiana are proud of Mr. Jordan's work which has been extended to other Indiana cities than Indianapolis.

Caisson Cofferdam Foundation With Special Bracing

Deep Cellar Substructure in Filled Ground, First National Bank of Jersey City—Caissons Braced by Built-up Struts During Excavation—Toe Wall Holds Caissons Against Sliding—Waterproofing

By T. Kennard Thomson
Consulting Engineer, New York City

CERTAIN special requirements arising from the ground conditions and from the construction procedure adopted led to the development of new arrangements of bracing in the caisson-cofferdam substructure of the First National Bank of Jersey City, recently completed. The temporary timber bracing by which the cofferdam wall was held during the work of excavating the interior of the cellar was concentrated in a small number of compact struts, leaving large open spaces between, through which the excavation could proceed. This arrangement was used in place of the ordinary system of closely spaced vertical bracing frames because the contractor wanted to carry on the excavation work more systematically and expeditiously than is possible when the lot is filled with a large amount of bracing. After the steelwork of the building had been erected and wedged into bearing against the caissons, to serve as their permanent bracing, the timber bracing was of course removed. A second new feature of the substructure is a toe wall of vertical I-beams concreted into the rock floor below the caissons and projecting up to hold the toe of the caissons from any possible inward movement. This device was used along the side of the cellar where the plane of cleavage in the gneiss rock on which the caissons rest slopes downward toward the building.

These two features are more fully brought out in the following account, which covers also some other interesting phases of the design and construction work.

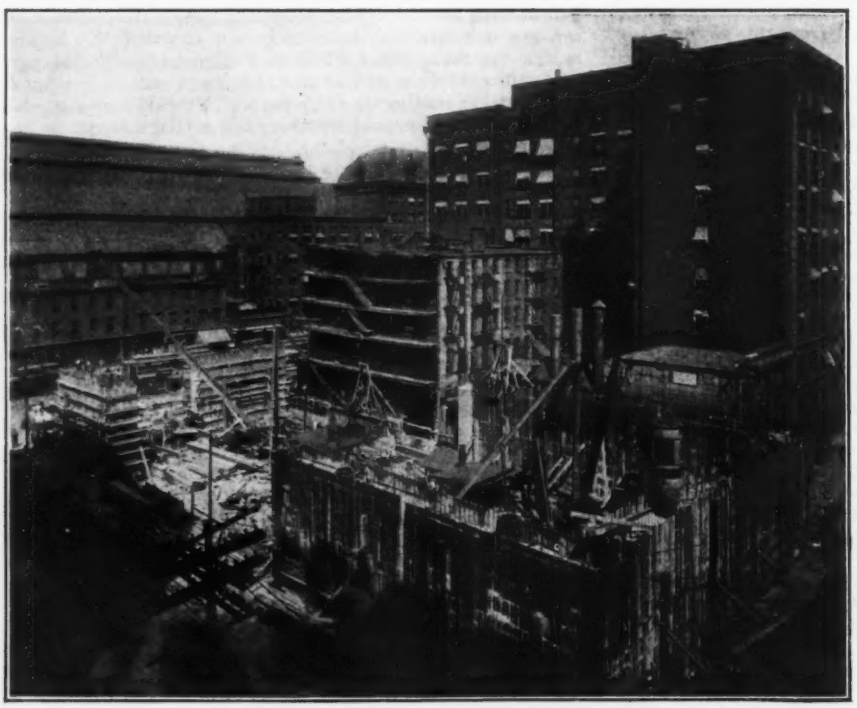


FIG. 1. CAISSONS BUILT FULL HEIGHT BEFORE SINKING

Site in Filled Ground—The building site, just south of the old Jersey City station of the Pennsylvania R.R. and west of the Colgate soap works with its big clock, was originally in the Hudson River. Formerly the river bank was on the west side of Hudson St., which borders the site on the west. Borings showed that the ground on which the building was to be erected contained a tangle of old timber cribs, piles, grillages, and the like. High tide still occasionally reaches street level at this point, although the groundwater level is ordinarily about 4 ft. below the surface.

As indicated by the original borings, the subsoil consisted of some 10 ft. of backfill, sand, clay, brick masonry, timber, and the like, below this 6 ft. of clay and sand, then 12 to 20 ft. of river mud, and a small amount of mica sand on top of 3 or 4 ft. of rotten rock. Bed rock was 25 to 35 ft. below street level.

We have found the same kind of rotten gneiss rock, though not always in such large quantities, in lower New York, as at the Mutual Life Bldg., and in fact, under most of the downtown skyscrapers. Recent borings indicate the same condition will be found under the New Cotton Exchange on William St., Beaver St. and Hanover Place, which is very close to Pearl St., the old water's edge of the East River. Conditions under the First National Bank are more like what is found along West St. in Manhattan, such as at the Barrett Bldg., (West, Rector and Washington Sts.), where a mass of timber grillages, piles and a large amount of rip-rap were also found. On the Manhattan side, however, we generally find the Hudson River silt rather than river mud as in New Jersey.

In Newark Bay we also find a great deal of Hudson River silt, and an especially treacherous quicksand overlying the rock; these conditions, however, vary considerably in different locations. At Perth Amboy we have driven 90-ft. piles in this silt without reaching bottom, and after ten days have loaded a platform supported on four of such piles to 160 tons without any settlement, although the piles had been driven in about 6 min. each with the steam hammer of the driver following the pile under water to the river bed, and with no increased resistance or sign of more compact material when the driving stopped.

The bank site occupies the block on the east side of

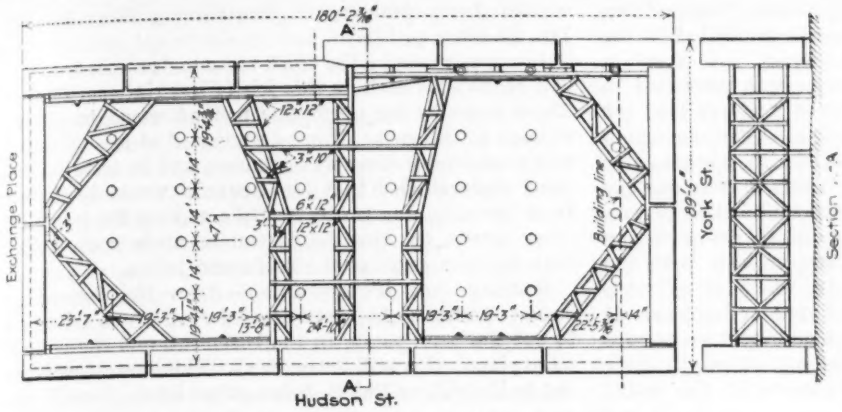


FIG. 4. BRACING OF CAISSON COFFERDAM
Concentrating the bracing gave large open working spaces.

Hudson St., with a frontage of 180 ft., and a width of 84 ft. on Exchange Place and 89 ft. on York St. The old bank building was located at the north or Exchange Place end. It was first planned to build on the south end of the lot before disturbing the bank occupancy, then transfer the bank, take down the old building and complete the new structure. There were several disadvantages in this plan: increased cost and longer time required for construction, and the necessity of underpinning the south wall of the old building. Fortunately, the bank succeeded in finding temporary quarters elsewhere and it was possible to build in a single operation.

Alternate Foundation Plans—The original design for the new building placed the basement floor at street level and provided foundations comprising a circular caisson for each column. This construction would have cost more and taken a longer time to carry out than the plan adopted. It was next contemplated to put in a deep cellar at the south end of the lot, to receive the boilers, and provide individual caissons under the other columns, thirty-seven in all. But it was realized that by putting in a deep cellar over the entire site the total cost would be reduced and at the same time some 25,000 sq.ft. of floor surface would be added; the value of this additional floor space alone exceeded the entire cost of the foundations. For this reason, the deep cellar plan with caisson inclosure and with interior columns founded directly on the rock floor of the excavation was finally adopted.

In the enclosure cofferdam as designed, with caissons 7 ft. wide with lengths varying from 29 ft. 11½ in. to 36 ft. 8 in., fifteen caissons were required. They were carried down to good rock, about 30 ft. below street level. This rock, New York gneiss, is usually overlaid by several feet of badly decomposed rock, often soft enough to be taken out with a shovel, and sometimes extending down into deep crevices where it may be hard to detect and remove. The depth of basement as planned was sufficient to carry the entire construction well below the level of the decomposed rock and in fact extend several feet into the sound rock.

At the north end of the lot, the party wall of the property adjoining to the east is carried directly on the caissons. To make the work here practicable, the party wall was taken down and subsequently re-erected on the caisson foundation; the owners were paid *pro rata* for the time the building was disturbed. South of this, it was possible to arrange with the adjoining owners to place the caissons in large part on the adjoining lot, as indicated by the offset shown on the plan. By making the cellar 6 ft. wider here it was possible to provide for getting the elevators down to the basement without cutting the caissons, as had to be done at one point near the northeast corner.

FIG. 2. ARRANGEMENT OF CAISSON COFFERDAM
Reinforced-concrete cap continuous around lot

Caissons Design—As already mentioned, the cofferdam caissons were made 7 ft. wide. The writer has often been criticised for using so great a width, in place of 5 or 6 ft., but in every case the greater width made a better and quicker as well as a cheaper job.

The 5-ft. width is too narrow for quick work in excavating and sinking the caissons. In one specific case it took one-third longer to sink 5 x 19-ft. caissons than to sink 8 x 26-ft. caissons on the same site, with the same number of men per caisson. It is also easier to keep the wider caissons in line vertically and horizontally. Further, their extra weight and strength simplify and cheapen the bracing.

Continuous concreting of each caisson from cutting edge to bottom of concrete caps was stipulated in the contract. This requirement was carried out except in three caissons, where the contractor was permitted to build up in two sections in order to avoid cutting the floor joists of the adjoining building. Continuous concreting avoids horizontal joints, which always give trouble sooner or later, producing nasty looking seepage lines. I had used it in three important buildings previously, with caisson heights 20 to 30 ft. above cutting edge, and succeeded in doing away entirely with the ugly horizontal construction joints, which always contain more or less silt and milk of lime or laitance. It seems almost impossible to scrape or otherwise remove this substance in construction, and yet sooner or later it is either washed out or penetrated by the water pressure, producing percolation or leakage. Evidence on this point can be found in retaining walls along several railroads near New York, where unusual pains and expense had been taken to clean the top of a day's work before adding more concrete, but the formation of seams such as referred to was not prevented.

When all the concrete is placed before sinking is started, a caisson goes down easier and quicker and keeps its position better both vertically and horizontally. The practice is therefore economical. Less loading of caissons by pig iron or the like is required, moreover, because sinking can be continued without the interruption caused by concreting; any such interruption permits the soil to bind around the caisson to such an extent that additional weight and time are required to break the bond, and in some cases even jetting, with the danger of throwing the caisson more or less out of plumb or possibly warping it.

Where it is possible, then, by far the most economical way to sink caissons is to concrete all of the caissons before putting compressed air on any of them. Where this cannot be done, it pays to have as many as possible built before starting the pneumatic work.

Joints Between Caissons—A space of 8½ in. was left between caissons, with a view to using a clay joint placed by "stock ramming." The construction of this joint is practically the same as that used by the writer on the Assay Building, New York City, two years ago. The oak timbers or separators shown in the plan of the joint, Fig. 5, were bolted to the ends of the caissons before sinking. They serve the purpose not only of keeping the caissons from getting too close together, but also of preventing the clay rammed into the joint from spreading all over the lot. When I used stock ramming on the Commercial Cable Building in 1896, without such timbers, the clay was subsequently found to be 20 or 30 ft. away from the joint in places. (Stock ramming on the Mutual Life Bldg. was described in *Engineering News* of March 28, 1901, p. 221, and that on the Assay building in *Engineering News-Record*, Jan. 22, 1920, p. 165.)

Joints as made by the stock-ramming process actually cost about $300 each on this job (First National Bank). Those made by the pneumatic method would have cost at least $2,000 each. Thus a saving of at least $25,000 and considerable time was attained, and in addition we could feel satisfied that less material would be drawn from the adjoining property while making the joint; in other words, the clay joints can be made more safely than the pneumatic or the half-moon joints.

Drainage and Waterproofing—After the deep-cellar design of building had been decided upon it was arranged to put the bank vaults in the basement, and the boilers were placed at a still lower level. This meant excavating to El.-25.5, or 38.5 ft. below street level. Some 3,000 cu.yd. of good rock had to be excavated to reach this level.

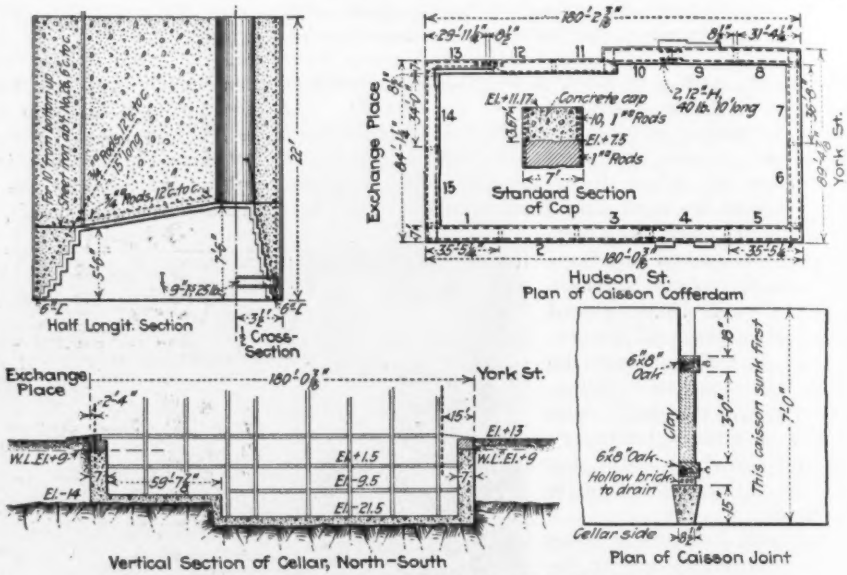


FIG. 5. BRACING AT NORTH END OF COFFERDAM

Caissons stopped on sound rock. Excavation inside carried down 12 ft. lower. Along west side a steel toe-wall was built to hold the caissons against possible sliding of rock on inclined seams.

Drainage necessarily received very careful consideration. If there is any cellar in lower New York 20 or 30 ft. under water without some seepage through fissures in the rock, I have not seen it. Further, concrete caissons under such a head are practically never wholly watertight. Theoretically they can be made so, but practically most of them will show occasional wet spots. This fact and also the fact that any masonry wall even of less than 1-ft. thickness, let alone 7 or 8, will collect an enormous amount of condensation when subjected to changing temperatures, made it advisable to provide drainage along the caisson walls also. Therefore, in addition to making the caisson concrete of the best possible quality, the inner face was later lined with hollow tile, waterproofed with tar and felt, and an enameled brick wall laid up inside of this to hold the waterproofing in place. If any water should ever seep through the walls or joints, it will simply pass through the hollow tile to the sump.

In the bottom of the excavation a 10 x 10 x 10-ft. sump was blasted out of the rock to receive all wall and floor drainage. Over the entire botton of the excavation a 6-in. layer of broken stone was placed, with lines of

tile duct draining to the sump. A 4-in. layer of concrete was placed on top of the broken stone, then tar and felt waterproofing and then a main floor slab of 24 in. of concrete.

While these elaborate drainage provisions might indicate that there was considerable water inflow, it should be said that this particular cellar is remarkably dry; very few cellars of this size and depth below water will require so little pumping.

Preparing the Ground—Under the particular circumstances existing at this site it would have been an expensive and slow matter if caisson sinking had been started from the surface of the ground. The mass of piles, grillage and cribwork, riprap, etc., below ground would have introduced very troublesome delays in sinking. For this reason open sheetpile cofferdams were driven, and the ground between them excavated deep enough to permit removing all this obstructing material in the open. Some of the timbers removed were oak sticks 14 x 20 in. and 20 ft. or more long, some of them in excellent state of preservation. After the obstructions had been removed, the trenches were backfilled with cinders to ground level, a depth of 10 to 15 ft., and the sheetpiling then pulled, to permit constructing the caissons at ground level.

The weight of the caissons due to their being made 7 ft. wide, and the removal of obstructions as just described, made it possible to sink the caissons with almost no extra weight in the way of loading by cast-iron blocks or pig iron. In some caisson work, such loading is necessary to the extent of 200 or 300 tons per caisson.

Rapid Build-up—The first two or three caissons took a day and the best part of the night to complete the concreting from the cutting edge up to the top, a height of about 26 ft. The other caissons, however, were all completed between 7 a.m. and 6 or at the latest 9 p.m.

Rapid Sinking—In sinking, care was taken to arrange the work so that adjoining caissons would never be in progress of sinking at the same time. The entire sinking was done between Sept. 10 and Oct. 11, 1920, working two sets or six gangs of men (three 8-hr. shifts). The depth at which the cutting edges were stopped ranged from 25 to 29½ ft. below street, but the cutting-edge excavation and concreting usually went down deeper, on account of the excavation required through decomposed rock.

Special Cofferdam Bracing—The temporary bracing required to hold the walls against the earth pressure from the outside while the interior of the site was being excavated and before the permanent steelwork was in place was concentrated in three heavy, built-up struts in the center of the lot and one heavy diagonal strut at each of the four corners. They bore against three heavy lines of waling timbers placed against the caissons. This bracing, designed for about 12 tons per lineal foot pressure against the cofferdam wall, was so arranged as to present the least possible obstruction to the excavation work and to the steel erection. T. B. Bryson, vice-president of the Holbrook, Cabot & Rollins Corp., made the general design for this bracing, which was then worked out for him by Carlton Greene, consulting engineer.

Caisson Toe Wall—Carrying the caissons down to basement floor level would have required sinking them through 12 ft. vertical of good rock on the average. This work, under compressed air, would have much more than doubled the cost of the caisson sinking and with the same men and equipment would have taken at least a year longer. It was decided, therefore, to excavate in the working chamber to good rock only, and to make sure that the rock was such that there would be no liability of the caisson ever slipping into the cellar. After excavating the cellar, however, it was found that on a portion of the west side of the lot there were some bad fissures in the rock, with planes of cleavage sloping toward the cellar. It was feared that at some time in the future the softer material in these fissures might gradually wash out, allowing a bad slide. To prevent any such danger a steel and concrete toe wall was built in front of the caissons, securely anchored into the rock of the cellar floor.

This wall was constructed of twenty-two H-beams, 24 in. by 80 lb., reinforced with 10 x ⅜-in. cover plates, concreted into holes in the rock 4½ ft. below the finished

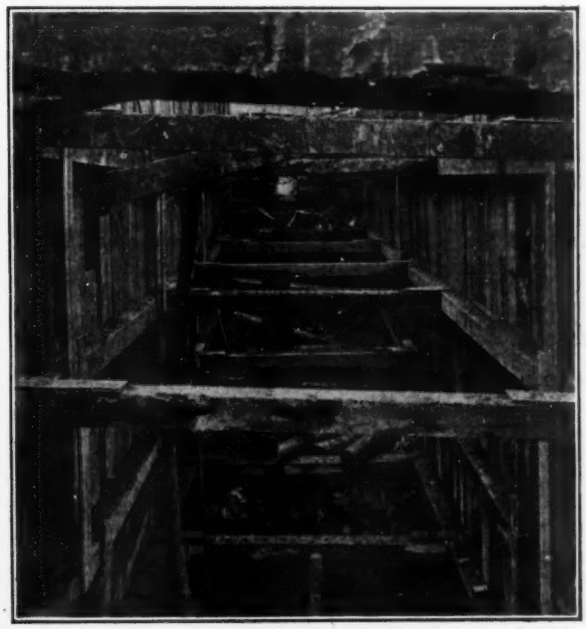


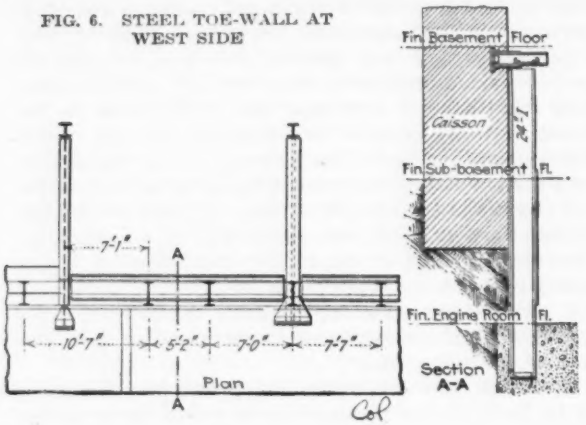
FIG. 3. BURIED TIMBER TAKEN OUT THROUGH TRENCH
The trench was backfilled after the dock cribbing and other old timber was removed and the caissons started above water level.

engine-room floor, the tops of the beams being held by the basement floor. These beams are nearly 30 ft. long. They were fully incased in concrete. In designing this wall, a hydrostatic pressure of 75 lb. per square foot was assumed, and a stress of 18,000 lb. per square inch was allowed. This is the first case I know of where the rock under pneumatic caissons has been so braced.

The entire construction, including the caisson sinking, blasting out 3,000 cu.yd. of rock in the cellar, bracing and erection, was carried out so carefully that there were very few accidents, and none of serious kind.

E. L. Young, president of the bank, gave this work his personal attention, assisted by James E. McKay. Alfred C. Bossom, New York, was the architect of the building; Arthur Zimm was general manager for the architect. John Lowry, Jr., was general contractor, with George A. Davis as superintendent in charge. Daniel Hughes was the superintendent for the foundation sub-contractors, Holbrook, Cabot & Rollins. Bigelow

FIG. 6. STEEL TOE-WALL AT WEST SIDE



& Nichols were engineers and contractors for the steel-work. All these parties worked harmoniously and well together, which insured the first-class results that were obtained. The writer was retained by the architect as consulting engineer.

Jointed Concrete Pavement in New York State

New Design Calls for Separately Reinforced Slabs 33 x 9 Ft., Separated by Submerged Steel Plate Joints

A JOINTED-SLAB construction has been adopted for concrete roads in the State of New York. The new pavement for 1922 is an 18-ft. slab, with a submerged steel-plate joint down the middle and one across the slab every 33 ft., and a wide expansion joint at least every 300 ft. Heavy reinforcement particularly of corners and edges is required. With a richer concrete, these details definitely raise the quality of construction. Also, with two thicknesses of slab and two types of reinforcement, four different pavements are available to meet different traffic conditions. Figs. 1, 2 and 3 indicate the new designs in all essential particulars.

Division longitudinally of the pavement slab is the result of observation of recent pavements where this separation in complete or partial form has been tried out and of older pavements built as one slab. The older concrete pavements show the principal deterioration during the first five years to be the development of a zig-zag longitudinal crack. On the contrary two-strip slabs, with the strips not more than 10 ft. wide, show after four years few longitudinal cracks. In a similar way observation indicates the development of a cross-crack every 30 ft. or so. The theory of the new design is to forestall the longitudinal and transverse cracks by making joints in the slab, one down the middle and about three across the slab in every hundred feet. These joints are independent of the bitumen filled joints put in to take up expansion.

A steel plate, with its bottom bent out at right angles to form a flat base, as shown by Fig. 3, forms the joint. The only exception, considering expansion joints as out of count, is when the two strips of slab are built separately at least 14 days apart. In this case the second strip of slab is butted up against the hardened edge of the first strip without the intervening steel plate. The height of the steel plate is ½ in. less than the thickness of the slab, which is uniform in depth and 6 or 7 in. thick according to the design. All joint plates are, therefore, submerged ½ in. below the pavement surface. In case of the longitudinal joint a groove ½ in. wide is formed directly over the joint plate and deep enough to lay bare the top edge of the plate. At the transverse joints the slab is finished continuously over the joint plate.

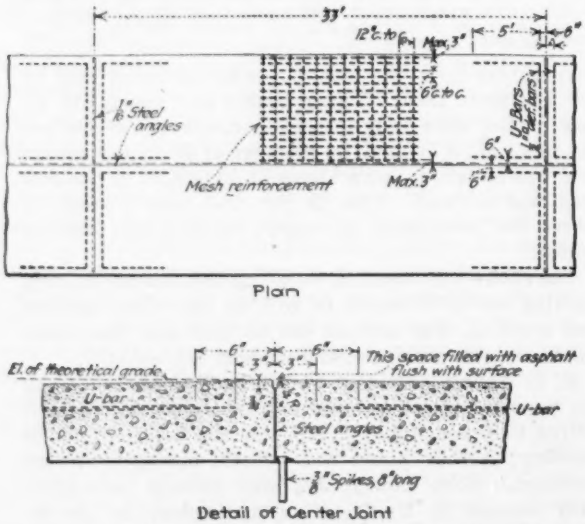


FIG. 1. MESH-REINFORCED SLAB AND SUBMERGED-JOINT CONSTRUCTION

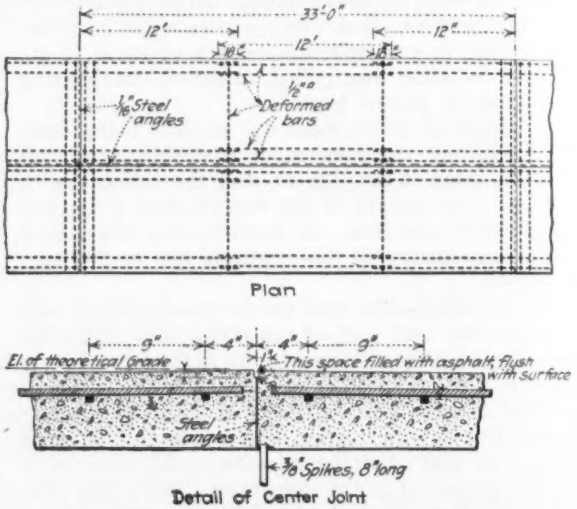


FIG. 2. BORDER REINFORCEMENT OF DEFORMED BARS

Great exactness is exercised in the construction of the joints. The plates are set exactly vertical and exactly to height and are firmly pinned to the subgrade as indicated by the illustrations. To keep the longitudinal plate in line and to give it lateral stiffness and also as a means of forming the groove, a cap-bar constructed as shown by Fig. 3 is fitted onto the top edge of the plate and when the concrete has set is lifted away. At transverse joints the longitudinal plate is broken; the transverse joints are formed by two plates each about an inch shorter than half-width of the slab. At all joint intersections, therefore, there is a complete break in the plate separators in both directions. Particular effort is made to see that the cross joints in

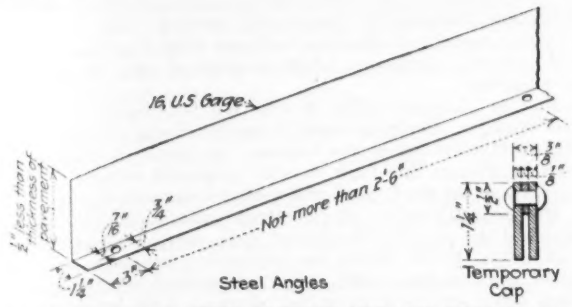


FIG. 3. DETAIL OF STEEL JOINT-PLATE AND GROOVE-CAP

opposite slab strips register exactly, for any offset in the joints in the two strips results in cracking as indicated by Fig. 4. The same thing happens if the longitudinal plate and groove fail to register. This groove is finished with a sidewalk groover and, when the concrete is dry, is cleaned and filled with bitumen.

Expansion joints are distinct from the crack-regulating joint system described. They are located at the beginning and ending of all horizontal and vertical curves, at points of suspension of work at noon and night, and at other intervals not exceeding 300 ft. A joint width of ½ in. for each 100 ft. of slab is called for; or a 1½ in. joint for a 300-ft. section. A pre-molded bituminous

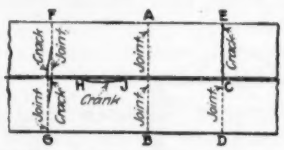


FIG. 4. CRACKS CAUSED BY IMPROPER JOINT-PLATE LOCATION

When the two joints are exactly opposite as at AB, the crack opens up squarely over the steel plates and straight across the slab as intended by the design. Where the plate, as CD, in one slab "breaks joint" widely with that in the opposite slab a crack as CE continues the joint across the opposite slab. In the offset of the opposite joint plates is small, such as might follow from careless workmanship, the result is one or two spalling cracks as shown at FG. If the longitudinal plate and groove do not register, a spalling crack as at HJ results.

joint filler is required. Considering a 300-ft. section of pavement there is an expansion joint at each end and between them nine crack-regulating transverse joints and the continuous longitudinal joint, dividing the section into twenty separate slabs.

Partition of the pavement into separate slabs is further recognized in the design of the reinforcement. Two types of reinforcement are contemplated as indicated in Fig. 1 and Fig. 2. With both types each 33 x 9 ft. slab is reinforced as an independent structure. The reinforcement is not continued across joints nor are dowels employed. With mesh reinforcement the wires are required to have effective areas of 0.073 sq.in. longitudinally and of 0.029 sq.in. transversely. This gives a weight of reinforcement of 63 lb. per square and the addition of the U-bars to strengthen the slab corners increases the weight to about ¾ lb. per sq.ft. The bar type of reinforcement is indicated by Fig. 2. It will be noted that a border reinforcement of fairly large bars is employed.

Construction, except as indicated in connection with joints and reinforcement, follows ordinary practice. A 1:1½:3 concrete is sought, preferably of broken stone aggregate. The joint and reinforcement design as described has been developed by the engineers of the department, Fred W. Sarr, first deputy commissioner.

Progress in Water-Wheel Design

Reports from Manufacturers Abstracted by Hydraulic Power Committee of the National Electric Light Association

THE principal features of progress made during the past year in the design and construction of water-wheels and governors are: the further development of the high speed runner, the flaring draft tube, the further application of the overhung runner to the reaction turbine, the further development of the governor to meet operating conditions and the special requirements of remote control and automatic plants; and the further refinement of structural details of both wheels and governors.

The development of larger units and lower heads has increased the demand for wheels of high specific speed. To meet this demand the unshrouded or propeller type of runner is rapidly developing in various forms. Experience so far

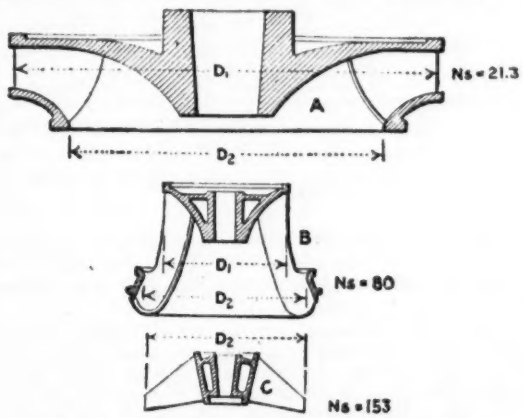


FIG. 1. RELATIVE SIZE OF FRANCIS AND PROPELLER TYPE RUNNERS

has well established the advantages for low-head work of this type in speed, strength, weight, few number of vanes, freedom of water passages, simplification of setting, possibility of using coarser racks and, on account of the low torque from closed gate leakage, its suitability for remote control and automatic plants. Although there has been among manufacturers a decided difference of opinion as to the liability of pitting with this type of runner, the Allis-Chalmers Company's experience so far indicates that comparative freedom from this feature can be obtained by proper attention to design.

The Hydraucone (White) and spreading (Moody) forms of draft tube, both for large installations and for low heads, have been further developed, and other forms of straight, flaring or spreading types designed to utilize both the whirling and axial elements of runner discharge are under consideration.

An interesting suggestion has been made (Taylor) that where future progress in higher specific speeds and higher heads may require the submergence of the runner below tailwater, excessive draft-tube excavation may be avoided by inverting the setting admitting water below and discharging upward and outward over a circular weir and syphon draft tube. Another adaptation of setting (Moody) to compensate for excessive rise of backwater during flood is the use of the ejector principle in bypassing part of the flow around the runner into the draft tube.

The development in governors has been largely to better meet operating requirements. Thrust bearings have seen little change.

The following statements have been submitted by various manufacturers.

The William Cramp & Sons Ship & Engine Building Co. I. P. Morris Department

High Speed Runner—The demand for higher speed runners has become more insistent, due to the trend for large

size units under moderate or low heads. Fig. 1 shows two Francis runners, and below at the same scale a propeller type. A comparison of these runners, which develop the same power at a given head but at speeds corresponding to their specific speeds, shows the great power developed by the propeller type compared to its dimensions. Specific speeds up to about 160 have been reached with this type with good efficiency. The advantages of the propeller over the Francis runner are: (1) Decreased first cost of development due to smaller generator, lighter shaft, lighter runner, lighter cranes, etc.; (2) greater strength in runner;

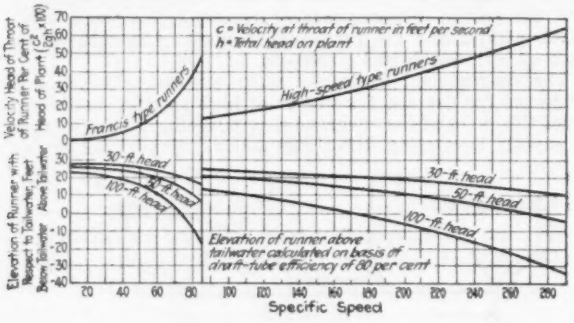

c = Velocity at throat of runner in feet per second
h = Total head on plant
Francis type runners
High-speed type runners
30-ft. head
50-ft. head
100-ft. head
Elevation of runner above tailwater calculated on basis of draft-tube efficiency of 80 per cent
Specific Speed

FIG. 2. COMPARISON BETWEEN FRANCIS AND PROPELLER TYPES

(3) non-clogging operation due to much greater clearance between vanes; (4) replaceable vanes; (5) less danger of corrosion due to more direct water passages and simpler vanes.

In Fig. 2 the curves of specific speed plotted against velocity head at discharge indicate the total energy discharged and show that the limit as to specific speed, which was being closely approached by the Francis design, has been for the present eliminated. The curve for Francis runners becomes very steep after a specific speed of 80, whereas with the propeller type much higher specific speeds are possible at relatively low outflow. The curves beyond a specific speed of 160 are theoretical, as propeller type runners have been developed only to about this speed.

Draft Tubes—As the water leaves all high-speed runners as a whirling mass, and a curved draft tube can regain only the axial component of the velocity, considerable losses result from using such tubes with high-speed runners. To regain efficiently the energy discharged the following requirements must be met: (1) The axis of the tube should be a straight line coincident with the axis of the turbine. (2) The walls should be surfaces of revolution about this axis. (3) The areas normal to the axial components should gradually enlarge and the tube spread out symmetrically from top to bottom, resulting in gradual deceleration of both axial and whirling velocities.

The Moody spreading draft tube meets all these requirements. Such tubes are not only desirable for high specific speed runners, but also prevent vibration in high head plants where low specific speeds are used as a whirling effect is present at part gate and the tube recovers this component and prevents the formation of the eddies and vortices which produce vibration.

Inverted Turbine—The lower curves of Fig. 2 show the possible elevation of runners with respect to tailwater for different heads and specific speeds. The elevation is governed entirely by the total draft head and, as this is made up of both height above tailwater and the velocity head at discharge of the runner, it is evident that as specific speed increases for a given head the runner must be lowered. Also as head is increased for a given speed the runner must be lowered. Although the propeller type has given more margin, the time will come when for higher heads, or if developed to higher speeds, the runner must be located close to or below tailwater. To overcome excessive draft tube excavation and permit of inspection without stoplogs in the mouth of the tube, H. B. Taylor, of the Cramp Compnay, has suggested inverting the turbine, admitting the water below and discharging it vertically upward. Fig. 3 shows an arrangement of inverted turbines with a circular weir and syphonic discharge, which permits of easy inspection by pumping.

Ejector Turbine — The Moody Ejector Turbine makes provision for admitting water from the casing directly into the draft tube below the runner. In times of flood and high backwater this high velocity by-passed water is used to increase the draft head and tends to maintain the power.

Mechanical Details.—(1) Sectional spiral casing. To prevent leakage in radial flanges of large volute casings under high heads, H. B. Taylor has designed a special casing in which the separate speed ring is eliminated and the speed ring vanes are cast in radial sections with longitudinal flanges for bolting to casing proper. This enables radila flange bolting to be carried into the throat and prevents leaking. The design is used on the 55,000-hp. units now under construction for the Queenston-Chippawa Development.

(2) Labyrinth Seals for Runner. Labyrinth seals giving six seals for leakage past the runner in high head units have been developed. These not only decrease leakage, but wear also.

(3) Disc Guide Vane. To prevent leakage between guide vanes and distributor plates, the Overn disc vane utilizes discs cast at junction of vane and stems, which discs are set flush in distributor plates and effectually prevent flow above or below the vane.

(4) Operating Gear. A new type of operating gear has been designed by F. H. Rogers, in which the lever attached to the guide vane is offset from its usual radial position and, as the vane closes, turns further away from radial

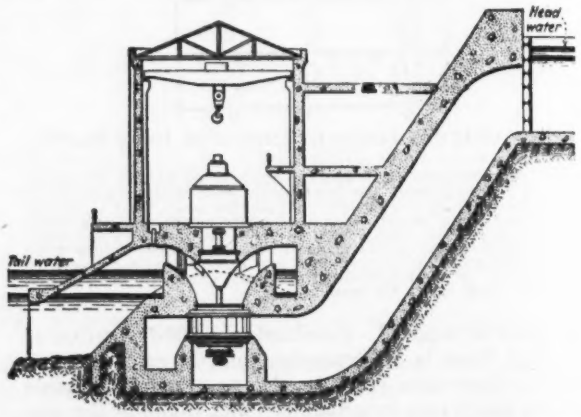


FIG. 3. PROPOSED INVERTED TURBINE IN POWER HOUSE
Devised by H. B. Taylor. Note that the wheel has a circular weir and siphonic discharge.

position. By using links in compression a toggle action is obtained which gives the desirable features of (1) greater angular turn of vane at large loads than at small loads and (2) maximum torque on vane in closed position, resulting in improved speed regulations. A shearing section in the links gives protection against injury due to a block vane.

(5) Lubrication of Internal Parts. For lubricating high head units H. B. Taylor has developed a large pneumatically operated grease gun with piping to guide vane bearings, etc., which insures sufficient pressures to force grease in against the head, which is difficult and slow with hand-operated cups.

Allis-Chalmers Manufacturing Co.

High Speed Runner Development—The operating data on Allis-Chalmers high-speed runner installations now available cover five years and thirty-four commercial installations. Runners range in discharge capacities up to those comparable with the Keokuk units, in size up to a diameter of 13 ft., in installed capacity up to a plant horsepower of over 8,000, in heads up to 35 ft., and in speed up to 3,600

revolutions. Complete test data have been obtained up to heads of 55 ft., and for draft heads up to 20 ft. Information on pitting under heads considerable enough to warrant looking for such effect is available over a period of operation up to four years.

Based on all data available, it is the present opinion of the Allis-Chalmers Co. that specific speeds in excess of 150 English System should not be utilized for heads greater than 30 ft.

Although a greater tendency toward pitting exists than with reaction turbines, there has been no case sufficiently extensive to warrant any fears but that this feature can be taken care of in perfecting design.

Efficiencies have steadily increased from initial figure of 86.95 at Holyoke in 1916, several per cent having been gained in improved design of runner and particularly through axial flow guide case settings. Specific speeds up to 240 have been reached with commercial efficiencies.

Regulation has shown no results at variance with those obtainable with reaction runners.

The non-clogging feature which permits wide rack spacing reduces not only the first cost of racks, but greatly lessens the necessity and cost of racking. This feature has proved of value in automatic plants.

The Wellman-Seaver-Morgan Co.

There have been no radical departures in turbine design during the last year, but rather perfecting and improving of mechanical details. A tendency is noted for some power companies to revert to oil bearings with babbitt linings for vertical shafts where there is sand in the water, special oil catchers and seals being necessary to prevent loss of oil. New breaking links and gate pins have been designed, and special study given runner seals to prevent leakage on high heads. Methods of heating gates to prevent ice clogging have been applied. Remote control for governors has been developed to a high degree.

For low head open flume turbines improvement in part gate efficiency and reduction of cost without losing heavy, rigid construction have been given much attention.

Draft tube design is being still further investigated.

The Pelton Waterwheel Co.

There have been no improvements of special importance in impulse wheel design during the past year and, as far as known to us, no notable installations other than the one 25,000-hp. double-overhung Pelton wheel, installed at the Big Creek Power House No. 2 for the Southern California Edison Company. This unit is of the auxiliary relief needle regulating type with speed regulating governor servo-motor mounted directly on the rear end of the power needle stem.

This year has seen the starting of the Kern River No. 3 Plant of the Southern California Edison Co., which contains two vertical Pelton reaction turbines, each developing 25,000 hp. operating under a head as high at times as 810 ft. This operating head establishes a world's record as far as known, and there are many features of special design that are worthy of mention. (1) The automatic equalization of pressure on the upper and lower sides of the turbine runner. (2) The automatic supply of cooling water to the shaft stuffing-box. (3) The automatic drain of seepage from top of casing. (4) The automatic continuance of oil pump operation by water-wheel drive, in the event of failure of electric motor service. (5) The automatic sharing of the available water supply by the two turbines during periods of low water. Water not required by one unit is automatically transferred to the other, which acts as a block load carrier. (6) The automatic adjustment of water consumption to conform to the available flow. The two turbines will not only automatically use what there is, but in addition use it constantly and without loss over the spillway during times of governor movement for speed and load regulation.

We have made important progress in the design of large horizontal reaction turbine units with overhung runners during the last year. The overhung type of horizontal turbine unit results in great simplification, as the entire equipment of generator and turbine may be mounted in two bearings, the thrust collar being combined with the outboard bearing. Economy of floor space and maximum accessibility are the direct result of this construction. We have during the past year completed several large horizontal units of this type, varying from 12,000 to 20,000 hp. each.

Is Cost of Treating Ties Capital or Maintenance Charge?

Two Engineers Advocate Opposite Methods—What Is a "Betterment"—Changes in I. C. C. Accounting Rule Urged

AN ECONOMIC question in railway valuation and accounting is the method of charging the excess cost of ties due to preservative treatment. Opinions differ as to whether this item should be charged to capital account or to maintenance. A paper advocating the latter method was presented at the recent annual meeting of the American Wood Preservers Association by Earl Stimson, chief engineer of maintenance-of-way, Baltimore & Ohio R.R. Since then an article presenting the opposite or capital side of the case has been submitted by F. S. Schwinn, chief engineer of the International & Great Northern Ry. For the benefit of engineers engaged in maintenance and valuation work abstracts are given below of both of these papers. It is to be noted that under the present accounting system prescribed by the Interstate Commerce Commission this cost is chargeable to maintenance. Further, a treated tie substituted for an untreated tie is not considered to constitute a "betterment," although a metal tie thus substituted would be a "betterment." It is Mr. Schwinn's argument that this accounting feature should be changed.

Tie Treatment is Maintenance Charge

By Earl Stimson
Chief Engineer of Maintenance: B. & O. R.R.

Funds to pay the cost of treating ties may be obtained from money earned or from money borrowed. Which way is the more desirable depends on the degree of prosperity of the railroad. If the earnings are large, it is desirable to put a portion back into the property, and in what better way than to invest in treatment for prolonging the life of ties. If the earnings are low, resort to capitalizing of the excess cost of the ties due to the treatment would be a means of meeting the expense.

While no specific mention is made of treated ties in the Interstate Commerce Commission's classification of expenses it is evident that the Commission does not consider the treatment of ties a "betterment," which it defines as follows: "Betterments are improvements of existing facilities through the substitution of superior parts for inferior parts retired, such as the substitution of steel-tired wheels for cast wheels under equipment, the application of heavier rail in tracks, and the strengthening of bridges by the substitution of heavier members. The cost chargeable to the accounts of this classification is the excess cost of the new parts over the cost of current prices of new parts of the kind retired."

Since the substitution of a metal tie for a wood tie is allowed as a betterment (or the substitution of a superior part for an inferior part) it may be argued that a treated tie is superior to the untreated tie, as far as its life is measured by resistance to decay. On the other hand the metal tie is unquestionably a substitution of a superior part, as the tie is made of radically different and structurally superior material.

The Commission evidently considers all wood ties the same, whether of soft or hard wood and whether untreated or treated. A wood tie is no better structurally after treat-

ment. It will carry no greater load and will not better hold the spikes. Under severe usage it will no better resist rail and spike cutting and other forms of mechanical wear, unless it is specially protected with tie-plates and screw-spikes at considerable additional expense. Under very severe usage the treated tie is destroyed as quickly as the untreated tie. The increase in the life of the treated tie is the only point upon which its superiority can be based But the same point might be raised in favor of white-oak or long-leaf yellow-pine substituted for red-oak or short-leaf pine.

There are many kinds of treatment, varying widely in cost and effectiveness. Their effectiveness is not always in direct ratio to the cost and it varies with the different kinds of wood. It is difficult after a few years to identify a tie as treated or untreated, or to identify the process of treatment, unless an elaborate record and method of marking for identification be initiated. Without such record it would be impossible to accurately separate the charges. The rapid rise in price of timber has increased the price of the tie in much greater proportion than the cost of treatment has increased. Less expensive treatments that have been found adequate are being used more and more in place of more expensive treatments. The result has been that the ratio of cost of treatment to price of the tie has greatly decreased, not only making the treatment show great economies but also reducing the proportion the excess cost of treatment bears to the total cost of the treated tie. This should in itself stimulate the use of treated ties and not necessitate resorting to the doubtful expedient of capitalizing.

The steady increase of the use of treated ties until now a large percentage of ties used are treated, rather nullifies the idea that the present method of charging the cost of treatment to maintenance is preventing a more liberal use of treated ties. Nor does it appear that charging to "investment in road" (that is, capitalizing) the excess cost of the metal tie has brought about the extensive use of that tie or made it even a competitor of the treated tie.

The writer has treated this subject from the standpoint of the maintenance engineer. He has taken into his maintenance costs the expense of treating some 12,000,000 ties and is reaping the benefits of the price paid. He is not and will not be compelled to continually give up some portion of those benefits in payment of interest charges, or in other words to pay tribute to capitalizing. He favors the present practice of charging the cost of treating ties to maintenance.

Tie Treatment is Capital Charge

By F. S. Schwinn
Chief Engineer, International & Great Northern Ry.

The railway maintenance engineer can no longer limit his horizon in considering repairs and renewals necessary for the property in his charge, but must include the viewpoints of the financier, the executive and the accountant. The primary need of a railroad is to earn money for operating expenses, fixed charges, improvements and reasonable return on its securities. The lack of sufficient earnings for all of these requirements is first felt by the maintenance departments. Still, some of those most vitally interested advocate the charging into operating expense of amounts representing improvements to their property, including the charging of the cost of treating ties to maintenance.

It is true that the classification of investment in road and equipment as prescribed by the Interstate Commerce Commission does not permit a charge of investment covering the cost of treating a tie used to replace an untreated tie. We are led to infer that the excess cost of metal ties over the current price of wood ties removed is the only betterment that can be obtained in a tie system. Are we to believe that a treated tie is no better than an untreated tie?

Treated ties have proved superior to untreated ties in overcoming decay. Their use results in economies of operation probably even greater than those secured from the application of heavier rails, ballasting of tracks, reduction of grades or the development of terminal facilities. The treatment of ties ordinarily will double their life and in that way will reduce operating expenses. Can it be that this is not an improvement, or a betterment of the property under a proper definition of the word?

In its railway valuation work the Valuation Bureau of the Interstate Commerce Commission has not valued the untreated tie as highly as the treated tie because it recognizes the difference in worth. There would have been very strenuous objections from the carriers if the Bureau had done otherwise. But under the Commission's valuation order No. 3 a carrier which may have used one million treated ties to replace untreated ties since its valuation date, at an increased cost over the cost to replace in kind conservatively averaging 50c. per tie, cannot capitalize this $500,000 improvement but must charge its value into the operating accounts. Should not the Commission amend the present accounting rules as affecting treated ties? By so doing, it would not only allow the carriers to earn a larger net operating income but would materially decrease their operating expenses, which decrease would finally be reflected in lowered rates.

It has been suggested that it would not be practical to keep accurate account of treated ties. This can be done very simply by use of a marker so that treated and untreated ties can be identified and classified when retired. Variations in cost and effectiveness of treatment cannot be used as an argument against charging the increased cost due to treatment to capital account. The cost of the same kind and size of untreated ties varies in different portions of the country and the Valuation Bureau did not argue that a flat price should be used for each size and kind of tie, regardless of local conditions entering into its cost. Neither can the increasing ratio of the cost of the timber to the cost of treatment have any bearing upon the principle involved. The treated tie will always cost more than the untreated, and the excess cost due to treatment will always be an appreciable amount.

More general treatment of hardwood as well as softwood ties is being strongly advocated, and it will not be many years before practically all ties will have to be treated as an economic necessity. It is this necessity which has caused carriers to attempt, through treatment, to increase the tie life from 75 to 100 per cent, regardless of how the cost was accounted for. But can they be expected to continue this practice when the accounting classification throws the expense into operating accounts and the Transportation Act limits their income? It is essential to the continued use of treated ties in annually increasing quantities, that the excess cost be properly accounted for as a betterment and that inconsistencies in the classification of investment in road and equipment be removed.

Indianapolis Uses Old Asphalt for Patches

Indianapolis this year is utilizing old sheet asphalt for making patches. The following details regarding the methods, which are not new but are being used for the first time in the Indiana capital this season, have been supplied by J. L. Elliott, city civil engineer:

"The old material when removed from the street, if still in 'live' condition, that is containing enough oil, is placed in a suitable kettle, after having been broken up, and boiled in just enough water to soften to a point where it may be used. The mixture is boiled long enough to drive off all the water, which sometimes requires only one-half to three-quarters of an hour. The remaining plastic mass is tamped back in the patch after the base and sides of the old pavement have been properly painted.

"Some of the patches made this winter have ironed out until at the present time it is hard to distinguish them from the original street. With the present methods we are employing, I have not recommended this type of work for more than small patch work but believe that with a little development it will be possible to do a great deal of the asphalt patching by this method, and thus leave the present hot asphalt plant free to do larger work."

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Developing Agricultural Engineering

Sir—The editorial in *Engineering News-Record* of May 11, entitled "Possibilities in Rural Engineering" is much appreciated by one who has been interested in the development of agricultural engineering for some 17 years. It appears to me that your observations are sound and that the engineering profession has a splendid opportunity to be of service to the industry of agriculture.

Those of us who are vitally interested in the development of this new profession would like to secure a common recognition of the term "agricultural engineering." Perhaps there is little choice between the names agricultural engineering, rural engineering and even farm engineering, but since the majority have decided that agricultural engineering is the best term we would like to have it generally recognized. Like mining engineering, agricultural engineering is the engineering identified with an industry. Anything that you may contribute in this direction will be appreciated. The work in the Bureau of Public Roads is now styled "Agricultural Engineering."

It may be of interest to you to know that we have had for some time at Iowa State College a full four-year professional course in agricultural engineering. This has the same general foundation as other engineering courses but includes enough agriculture to secure an appreciation and sympathy for agriculture and considerable specialization in agricultural engineering subjects. We have graduated to date 122 men and are proud of their records. We have found, however, that the best positions are not as independent practising engineers but rather as service engineers for some kind of an organization.

J. B. DAVIDSON,
Professor of Agricultural Engineering,
Iowa State College.

Ames, Iowa, May 16.

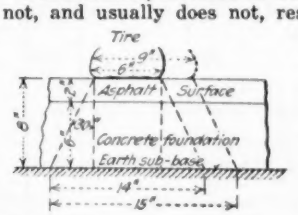
Wide Tires Not an Effective Remedy for Excessive Vehicle Loads

Sir—Readers of current literature on highways and highway transportation still meet with the assumption, stated or implied, that the effects of excessive wheel loading of power trucks may be obviated by increasing the width of tires somewhat in the same ratio as the loads. It appears to be not generally recognized that even if true with regard to the road surface—which in practice it usually is not—it is not true with reference to the foundation and is particularly erroneous with reference to the subfoundation (subgrade). Experience is teaching us that no small part of the failures of our improved roads chargeable to excessive wheel loads are due to the yielding of the subfoundation under pavements, depending largely upon its support.

The function of the pavement proper—the wearing surface and the foundation—is not only to resist the wear and tear of travel, but to transmit to and distribute the load-weight over a sufficient area of subgrade to carry it without such deformation as may deprive the overlying pavement of support, and thus cause its breaking down and failure.

The laws governing the transmission and distribution of force or weight through different materials is not yet well understood or defined. It is commonly considered that the angle of spread of force passing through various substances is 45 deg.; but in the case of pavement surfaces and concrete foundations it may not exceed 30 deg. Assuming this as a fair average the distribution of pressure to a subgrade from a 6-in. tire over a prism or cross-section at right angles to the path of a truck wheel, through a pavement having a 2-in. bituminous wearing surface and a 6-in. concrete foundation, will be as shown in the attached sketch, over a width of 14 in. If a 9-in. tire be substituted the distribution on the subgrade will be over a width of only 17 in. Thus, while the 9-in. tire increases (theoretically) the bearing area on the surface 50 per cent, it increases that on the subgrade only 21.4 per cent. It may be claimed that the bearing area should be considered and figured as circular rather than cross-sectional, but even in that case while the substitution of the 9-in. tire would increase the surface bearing area 12.2 per cent if would increase that of the subgrade only 47 per cent.

Furthermore, increase of width of hard-rubber tires may not, and usually does not, result in an equal increase of bearing area even on the *surface* of the pavement. The circular contour of the surface of new pavements with the ordinary amount of crown causes the pressure from wide tires to be more or less concentrated along the inner edge of the wheel track. This is particularly the case where unusually high crowns are permitted in the utilization of old macadam roads or other old paved surfaces, as foundation for the new pavement. As a result the whole width of a wide tire may not be effective in distributing the weight. Tests made by me many years ago by the use of carbon paper under the wheels of a loaded truck with steel tires 4 in. wide, over comparatively new and hard sheet-asphalt pavement crowned one-sixtieth of its width, showed that the effective bearing contact between the wheel and road surface did not average a strip more than 3 in. wide. Also, it is to be considered that pavement surfaces, after a few year's wear, became more or less uneven or bumpy, so that the whole wheel load may be concentrated upon a very small area regardless of the width of tire.



RELATION BETWEEN WIDENED TIRE AND PRESSURE ON SUB-BASE

A consideration of these facts seems to disprove that apparently generally accepted proposition that widening the tires is an effective remedy for excessive loading or weak pavements.

S. WHINERY,
New York City, May 3. Civil Engineer.

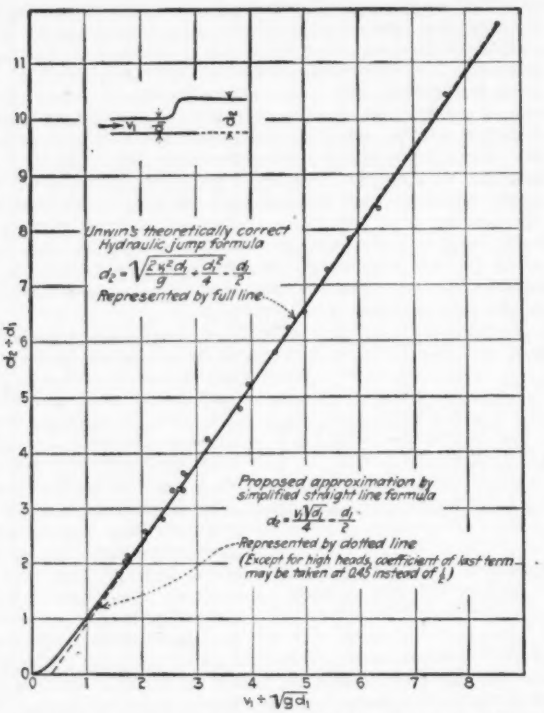
Early Studies of the Hydraulic Jump

Sir—I read with a great deal of interest Mr. Ewald's discussion, in your issue of May 4, p. 748, of the priority of his first experiments on the absorption of energy in the jump. I had occasion to review his 1914 report in the office of John R. Freeman.

Such studies were by no means new to Mr. Freeman's office at that time. The phenomenon first aroused his interest during the construction of the Wachusett Dam, twenty-two years ago, and the principle of its absorption of energy was frequently used thereafter, for example, in studies for the Mississippi River Power Co. at Keokuk and in the design of the high spillway dam at Holter, Mont., in 1910.

There are recorded a number of early experiments to determine the height of the jump but most of them are confined to relatively small heights and do not cover a wide enough range. For example they do not include such a condition as would exist at the toe of a high spillway. Two notable exceptions, both in 1914, and undoubtedly there are others, are those of Prof. A. H. Gibson of Dundee, Scotland, and those reported by Mr. Ewald.

The two experiments were of a different nature, however. Those of Professor Gibson were made in a smooth rectangular channel with the idea of a careful theoretical analysis of the general phenomenon. His results are plotted on the


Unwin's theoretically correct Hydraulic jump formula
Represented by full line
Proposed approximation by simplified straight line formula
Represented by dotted line
(Except for high heads, coefficient of last term may be taken at 0.45 instead of ½)
$d_2 + d_1$
$v_1 \div \sqrt{g d_1}$

FORMULAS FOR THE HYDRAULIC JUMP PLOTTED

accompanying chart and show remarkable agreement with the jump formula over a wide range.

Mr. Ewald's tests were of a much more practical nature with the definite purpose of studying conditions below a model of the high arched spillway of the proposed Cheoah Dam. As such they were very valuable and deserve much credit. It is unfortunate that there are not more experiments of this sort. However, they are not so valuable in helping to determine the correct formula for the jump.

The formula given in Mr. Ewald's letter, which, after correcting an obvious typographical error, is

$$d_2 = 2\sqrt{\frac{d_1 V_1^2}{2g}}$$

is known to be incorrect. The errors in its deduction were first pointed out in my paper on the subject before the American Society of Civil Engineers in 1915. Several analyses of the absorption of energy in the jump have been made, by Messrs. R. D. Johnson, B. F. Groat and others, all agreeing that the original Unwin Formula, found in Encyclopedia Brittanica, is correct.

I have plotted this formula on the accompanying chart, using the co-ordinates

$$\frac{d_2}{d_1} \text{ and } \frac{V_1}{\sqrt{g d_1}}$$

I have often found it very convenient to use a much simpler formula which is a close enough approximation,

$$d_2 = \frac{V_1\sqrt{d_1}}{4} - 0.45\, d_1$$

for low heads, as in flume and conduit discharge, and

$$d_2 = \frac{V_1\sqrt{d_1}}{4} - \frac{d_1}{2}$$

for a wide range of high heads.

Boston, Mass., May 12. KARL R. KENNISON.

Do Designers Use Diagrams?

Sir—In answer to your editorial inquiry of May 11th, "Do Designers Use Diagrams," the following discussion may be of interest.

Until a comparatively few years ago, the textbooks on reinforced-concrete design contained very few diagrams to assist the designer. The use of tables may have been an outgrowth of the practice in structural steel design but in any case the designers became accustomed to their use and in some cases have been slow to change their habits.

At the present time most designers use both diagrams and tables but use them to a varying degree. The lack of uniformity is in part due to the variety of stresses and other regulations in use which make the preparation of a satisfactory set of tables and diagrams for general use very difficult. Many diagrams are constructed according to local practice and would have to be altered for use in another location. Most offices have constructed such special diagrams which could not be used generally but might furnish valuable suggestions for the preparation of diagrams in other offices.

Every year there are a large number of men entering the field who are open minded and will use tables and diagrams prepared by others if they are satisfied with their simplicity and accuracy.

Tables and diagrams should be as comprehensive as possible without losing ease of application or hampering the designer in any way in the choice of sections or sizes. The completeness of the results obtained from a single diagram or table is also limited by the large number of variables encountered and the desirability of permitting a check on each operation. For example a table may well be prepared to give the total safe load on columns of desirable size and reinforcement but a table cannot well give the safe load on beams of concrete without placing undesirable limitations on the designer. In the latter case, there are too many variables to be handled in one operation and the problem is best solved by a combination of separate tables, diagrams or slide-rule operations, each of which may also be checked by inspection.

Tables, diagrams, and the slide-rule are all used for the purpose of simplifying the solution of formulas. In some cases the tables are the most appropriate and in others diagrams give more complete and satisfactory results because they often greatly condense the information and do away with the necessity of interpolating between the values of tables. For the solution of simple and easily remembered formulas the slide-rule is undoubtedly the easiest to use because the operation can be performed before the proper table or diagram can be turned to.

Of all the different operations involved in the design of a concrete structure, some are best suited to the use of tables some to diagrams and some to slide-rule while many can be equally well performed by two or more methods. It is quite natural that there should be a difference in the opinion and practice of designing engineers.

The design of concrete structures can never be standardized in the way that structural steel design has been. Both the monolithic structures of concrete and the material itself are more complex and one of the chief virtues of the material is the flexibility it allows in design. Tables and diagrams should be constructed with that in mind and although special diagrams may be made for particular jobs with certain factors fixed, their usefulness is limited.

It is the writer's opinion that all-embracing diagrams are not as suitable as separate diagrams which permit the effect of each variable to be noted and permit a check on each step as it is performed. All-embracing diagrams are more difficult to follow through and are specially dangerous in the hands of an inexperienced designer.

In the preparation of the "Concrete Designers' Manual," of which the writer is one of the authors, each operation involved in the design of a concrete structure was studied and the solutions presented either by table or by diagram whichever was judged from experience to be the most satisfactory method. Very simple operations were for the most part left to the slide-rule.

Milwaukee, Wis., May 14. CHARLES S. WHITNEY.

NEWS OF THE WEEK

New York, June 1, 1922

Propose a Study of Flood Outlets on Mississippi

Spillways Favored by Inhabitants Below Red River, Levees by Those Above

(Washington Correspondence)

Steps are being taken in Washington to insure a further investigation of the use of spillways at points a few miles below New Orleans in reducing the flood heights in the Mississippi River. Whether or not spillways can be used successfully for this purpose has been for many years a greatly controverted question in the lower Mississippi Valley.

On the Mississippi River above the Red River, there is great hostility to any proposal to supplement the levees as a means of flood control. This feeling is based primarily on the fear that it will dilute the appropriation for flood control and defer the time when all levees will be brought up to the grade and cross-section adopted by the Mississippi River Commission as standard.

The people below the Red River, however, are very determined, in view of the disasters accompanying this year's floods, to have a trial made of spillways. There is also agitation for the diversion of more water through the Atchafalaya River. The Atchafalaya offers the advantage of a route 150 miles nearer to the Gulf, but the diversion of more water would require the leveeing of the entire stream. In that connection there is more than the expense to consider because suitable foundations for large levees are not available on considerable stretches of the stream.

The Mississippi River Commission investigated spillway possibilities in 1913 and came to the conclusion that they could not be used to advantage. In summarizing its findings at that time, the commission held that such spillways as were proposed, constructed to carry 230,000 sec-ft., would be hazardous and expensive, with the disadvantages greatly out-weighing the possible benefits. Steps now are being taken looking to a further investigation of the spillway proposition independent of the Mississippi River Commission.

New Legislation Near

New flood-control legislation is to be initiated in the near future, but at the time of this writing the Senators and Representatives from the lower Mississippi Valley had not agreed finally on the exact form of the bill to b introduced. It is believed, however, that the plan of Senator McKinley, of Illinois, which provides that the federal government take the securities of the various levee boards and advance the money needed for a comprehensive scheme of flood control will be followed. The levee boards would pay four per cent interest, plus one per cent for amortization. In this way all the money for levee construction would be paid eventually by the states. Due to the heavy expenditures incurred during this high water fight, none of the levee boards is in a position at this time to float bond issues in the amount required for the work.

The states in the lower Mississippi Valley are not abandoning their contention that the federal government should bear a portion of the expense of levee construction since the flood waters come from many states. The federal government has acknowledged the national character of the flood control problem. In 1916 $45,000,000 was authorized as federal aid for the construction of levees. The money was appropriated however, in doles of $6,670,000 annually. Much larger annual installments could have been used to advantage and the failure of Congress to appropriate larger sums made possible, some contend, this year's disasters. All the crevasses and all the weak points that developed were in levees which had not been brought up to the grade and cross-section prescribed by the Mississippi River Commission. No standard levee, according to General Lansing H. Beach, the Chief of Engineers, showed the slightest weakness.

Jury in Cement Trial Disagrees After 34 Hours

Retrial as Soon as Presiding Judge Is Assigned; Reporting System Seems to Have Impressed Jury Strongly

AFTER having been out for more than 34 hours the members of the jury sitting in the criminal case against cement manufacturers of the Eastern district charged with a violation of the Sherman anti-trust law, were unable to reach a verdict and so reported late May 26 to Federal Judge Knox, of the Southern District of New York, before whom the trial was held. It is understood that the jury voted generally seven for acquittal and five for conviction. During its deliberations the jury asked for a reading of the court's instructions as to the interpretation of the Sherman law, and for copies of the forms used by the Cement Manufacturers Protective Association and its members in the statistical reporting system in use.

The case will be retired as soon as a presiding Judge can be assigned. In the meantime it is understood that the civil case against the cement makers, seeking primarily the dissolution of the Cement Manufacturers Protective Association, will proceed. The criminal case against the Mid-West manufacturers, it is also understood, will be pressed.

The trial began on April 6. Testimony and documentary evidence taken in the case covered more than 4,000 printed pages and more than 1,700 exhibits were offered in evidence by the government and the defense.

Accountants and others had been at work preparing evidence in the case many weeks before the trial opened and it is estimated that the trial has cost the government and the defense together in the neighborhood of $500,000. The indictment was returned on Aug. 8, 1921. Forty-four individuals and nineteen corporations were indicted.

Government's Case

It was the government's contention that the defendants had, first, entered into a conspiracy for the express purpose of unduly restraining interstate commerce (through fixing prices, uniform bag charges, uniform discount rates, bag-return allowances, etc.), when the Cement Manunfacturers Protective Association was formed in the latter part of 1916, and, second, that that same restraint had existed at all times since the formation of the protective association.

The second count in the indictment (that charging the entering into a specific contract for the restraint of interstate trade by the control of production, fixing of prices at an unreasonable level, fixing uniform bag charges, discount rates and bin-test charges and uniform bag-return allowances) was dismissed upon argument after the government had finished its case. The defense was able to prove to the satisfaction of the court that if the formation of the Cement Manufacturers Protective Association did constitute an undue trade restraint, the specific contract was entered into in 1916, whereas the indictment was returned in 1921. The statute of limitations, therefore, outlawed the contract and the defendants were held not liable. However, the court adjudged the evidence of sufficient importance to allow the case to proceed under the terms of the first indictment, which charged that by their participation in the protective association's activities the defendants had engaged in undue trade restraint.

Twelve Points Cited

In his summing up the case before the jury Roger Shale, junior government counsel, pointed to "twelve outstanding points of evidence:" the national association and its activities, the license association and what it sought to accomplish, the correspondence that passed among certain defendants after the dissolution of the license association and the formation of the Eastern Cement Association, the Eastern Association and its activities (it existed for only four months and was

Tunnel Workers Overcome by CO_2

Carbon dioxide which had entered the sewer tunnel under construction in National Ave., Milwaukee, Wis., on May 24, overcame five men—two workmen and three rescuers. Rescue was finally effected by men wearing oxygen masks.

dissolved upon advice of counsel), the correspondence among some of the defendants after the dissolution of the Eastern Association and the formation of the Cement Manufacturers Protective Association, the minutes of the protective association, its system of reporting, the activities of checkers who followed up for manufacturers the amount of cement ordered by agents and dealers for specific jobs, the arbitrary freight basing points, the freight rate books, the general uniformity of price quotations and "the general secrecy of the whole thing."

Former Associations

The government was allowed to bring into evidence activities of the defendants in associations that were formed far outside of the legal limit established by the statute of limitations, merely to show what the general tendency of the defendants had been in the exchange of statistical information. Of such a class of evidence was that which had to do with the national association, correspondence that passed between that time and the formation of the license association (which had to do with the association of seven of the largest manufacturers of the Eastern district for the control of a then newly-patented process of burning limestone with powdered coal), the activities of the license association itself, correspondence previous to the organization of the Eastern Association and the activities of the Eastern Association. During most of this time there was a strong tendency toward business cohesion among the cement makers, a fact that was characterized as most sinister by the government.

In further summing up for the government Judge Fowler, senior government counsel, asserted that it was not necessary for him to prove that the defendants had actually signed an agreement to restrain commerce, but that the evidence had shown the defendants to have followed a system of exchanging statistical information that could not but lead to uniform prices. Since nearly every witness testified as to the uniformity of price, bag charges, discount rates, bin-test charges and bag return allowances, he felt the case was indisputably proven for the government.

System of Reporting

In holding to such a theory he stressed the reporting system used by the protective association. There were twenty-odd reports in use which can be described briefly as follows: (1) Card reporting contract, showing its number, date, purchaser's address, description of work, location, contractor, number of barrels, the price and the delivery point; (2) card showing changes in contracts already reported giving contract number and delivery point; (3) report of all sales, cancellations and modifications of contracts for each day showing contract number, purchaser's name and address, delivery point, description of the work, brand of cement ordered, date contract was closed, expiration date, number of barrels sold, the price and a letter indicating the class of work (this card was circulated by the association among its members); (4) a summary accompanying the last-named form; (5) monthly summary of contracts let by each mill; (5) report showing the status at the particular time of contracts, cancellations, etc., (6) quarterly report giving a complete description of every live contract at the time the report was made; (7) form showing the percentage of committments of each company as compared with the previous month; (8) form showing total committments in each state, issued monthly; (9) report for any month compared with the corresponding month of the previous year; (10) report of each company on the total production for the month previous to the time the report was made, the percentage of clinker, etc.; (11) report of members to the association showing shipments for the preceding 15 days of the current month compared with the corresponding 15 days of the previous year; (12) the same information but compiled for all mills by the association; (13) analysis of contracts showing shipments on various classes of construction by states, issued quarterly; (14) form used by any member desiring a contract investigated; (15) form containing practically the same inquiries as on the foregoing but to be used by inspectors with reference to sidewalk and curb paving; (16) form notifying the member making the inquiry and any others interested; (17) monthly report from association showing total bags; (18) form provided by the association for reporting delinquent accounts; (19) summary of total passed-due indebtedness of each member; and (20) report by each member of accounts placed with attorneys.

Uniformity in Practices

Besides the elaborate system of reporting by which Judge Fowler accused the defendants of competing by telling their competitors "everything about their business" he said that the other parts of the system that must have meant conspiracy were certain uniform practices, the method of checking up on specific job contracts, and the meetings of the association.

As to uniformity of practice he pointed to the fact that in the eastern district there are three main points upon which mill prices of cement are based: the Lehigh, Universal and Hudson bases. Uniformity of price he said had been testified to many times, and particularly by the testimony of a Department of Justice accountant who said he had examined 50,000 contracts, selecting 928 at random. From these actual contract prices he had subtracted freight, bag charges and other known uniform charges, finding that the mill prices were uniform as between mills in the same district over a considerable period of time. Uniformity in practice also was evident from the testimony in bag charges, bin-test charges, discount rates, dealer differentials, etc. The use of freight rate books, wherein the rate from basing points to practically every rail point within the state for which the books were compiled, also evidenced uniformity of practice was the charge. Checking up on specific job contracts Judge Fowler asserted to be the best method of keeping track of every bag of cement, thereby controlling production.

Col. H. L. Stimson, chief defense counsel, in summing up his case, asserted that during the whole trial no clear statement as to what the indictment charged had been made by the government. He said that to prove the charge that the defendants had fixed excessive prices by agreement and that they had sold in quantities fixed by agreement, specific charges in the indictment, they would have had to follow one of three plans: (1) Pro-rate the production among the defendant mills from year to year according to the total production; (2) divide up the territory so there would be no competition as between mills in the same territory; or (3) pool earnings. No direct evidence had been introduced to substantiate any of these charges, was his contention.

The Cement Manufacturers Protective Association, he contended, was formed for the purpose of exchanging certain statistical and credit information and all of its deliberations had been set down in minutes which had been available to government inspection at all times. This point he emphasized—that the association had been investigated to a certain extent and complimented by the Federal Trade Commission for its activities in the establishment of certain standards of trade-association activities.

As to the uniformity of price that was testified to the defense maintained that competition often was so keen that a price uniformity was inevitable. Such a standardized product was susceptible of the same price uniformity as any other standard product, regulated from a central source as to quality of materials, standard tests, etc. As a prime example of the keen competition that had existed among the defendants was that in 1914 when Lehigh and Atlas fought for months in a price war. Cement started at 90 cents in December, 1914, and the price as cut by Lehigh in July, 1915, to 50 cents, the Atlas company refusing to go below 65 cents on the ground that that price was below manufacturing costs.

Basis of Defense Case

The defense based its case almost entirely on the theory that uniformity in price and in trade practices did not at all indicate the existence of a conspiracy. It held up as a principle of economics that the keener the competition the more uniform the price and the methods of disposing of the product. Competition had been so keen, it contended, that discounts had risen and that bin-test charges had been entirely eliminated.

As to the general charge that cement prices had been excessively high and that the manufacturers had profited liberally thereby the defense put in evidence figures compiled by the U. S. Bureau of Labor Statistics showing that of several score commodities cement had risen least of all, save beef cattle and crude rubber, and that during the time charged in the indictment the net return for most mills on invested capital as well as on plant value was under five per cent, whereas a return double that was considered more or less economically insufficient.

The defense case was enhanced by charts indicating production, shipments, stocks, etc, for each of the corporate defendants covering the past eight years and by other charts showing net earnings on invested capital and plant valuations. The defense defended the practice of basing prices on three or four points simply as one

(*Concluded on p. 929*)

First Step Toward a St. Lawrence Canal Treaty

The United States government has formally approached the Canadian government in the matter of negotiating a treaty looking to the deepening of the waterways to enable ocean-going ships to reach the Great Lakes.

The note of the Secretary of State to the British Ambassador called attention to the fact that on Jan. 21, 1920, the governments of the United States and Canada referred to the International Joint Commission for investigation and report, under the terms of Article IX of the treaty of Jan. 11, 1909, the questions relating to the improvement of the St. Lawrence River between Lake Ontario and Montreal, both for navigation and the development of waterpower. It was pointed out that the Joint Commission had reported on Dec. 19, 1921.

Secretary Hughes, in his note, stated that "he is authorized to state that the President favors the negotiation of a treaty on the basis of this report of the International Joint Commission, or such modifications as may be agreed upon." He asked to be informed "whether the appropriate British and Canadian authorities are disposed to undertake the negotiation of a treaty."

In answer to an inquiry in the Canadian Parliament Premier King has announced that Canada is not, at the present time, prepared to enter into any treaty.

Cincinnati Double-Track Railway Bridge Opened to Traffic

The new bridge of the Southern Ry. across the Ohio River at Cincinnati, a double-track structure replacing the widely known old single-track bridge, was opened to traffic on May 1. The old structure, with trusses of Whipple type, designed by Bouscaren, was completed in 1880. It had three principal river spans, of which the channel span was 520 ft. long. In place of these the new structure has a continuous structure of three spans, resting on the old piers, slightly widened to take the double-track superstructure. The new steelwork was built around the old. The swing span of the old structure on the south bank is replaced in the new bridge by a vertical lift span.

Foundation work began in February, 1921, and steel erection was carried on during the past fall and winter, being completed in February. Ralph Modjeski was engineer for the new bridge, and the American Bridge Co. fabricated and erected the superstructure. The Foundation Co. reconstructed the piers for the new work.

Board Opposes Newark Bay Bridge

Permission to build a four-track railroad bridge to replace an existing trestle over Newark Bay from Elizabethport to Bayonne has been denied the Central Railroad of New Jersey by the State Board of Commerce and Navigation of that state.

The board objects to the maintenance of a bridge at this place on the ground that it will hamper the use of the waterway and the development of the adjoining port and industrial facilities.

The Engineer in Public Life

COL. EDWARD ORTON, JR.

As president of the Chamber of Commerce of Columbus, Ohio, Col. Edward Orton, Jr., an engineer graduate, class of 1884, of Ohio State University, is a leading spirit for civic advancement in his community. He was born in 1863 and after completing his collegiate work he became a surveyor in coal mines and later entered the metallurgical field, subsequently becoming draftsman, chemist, and superintendent of blast furnaces in Ohio and Virginia. One of his chief activities has been in the field of the manufacture of brick, and he was one of the organizers, in 1898, of the American Ceramic Society. Col. Orton was state geologist of Ohio for eight years and for fourteen years served as dean of the College of Engineering, Ohio State University. During the war he was a colonel in the Motor Transport Corps and was awarded the Distinguished Service Medal. Since the war he has retired from educational work and has devoted his spare time to various forms of public service in Columbus.

Lumber Association Starts Education of Retailer

A correspondence school course has been started by the National Lumber Manufacturers' Association to educate the retailer in the technical features of lumber and its uses. Fifteen letters are to be sent out. Some of the subjects are as follows: Structure of timber and grading rules, projections and plan reading, figuring stresses and sizes, specifications, fire-resistive construction, wood preservation and heavy timber construction. At the end of each letter is a series of test questions, answers to which will be corrected and returned with the succeeding lesson. The end sought is to equip the retailer to meet the competition of other materials on the technical basis.

Council of Federation Holds Meeting at Pittsburgh

The Executive Board of the American Engineering Council of the Federated American Engineering Societies met at Pittsburgh May 26 and 27. The council adopted the report of the committee on registration of engineers. Other matters discussed were employment conditions, federal water power, government reorganization, reforestation, jurisdictional awards on labor, patent legislation, aerial research, waste in agriculture and foreign relations.

It was announced that 30 societies are now supporting the federation, with individual members numbering about 60,000.

Highway Traffic Measures Approved at Convention

Reports Outline Plans for Uniform Marking and Increased Safety Especially at Curves

Approval was given by the National Highway Traffic Association at its annual meeting in New York, May 12, to measures, embodied in committee reports, looking to greater uniformity in marking highways and to increased safety, particularly at curves. The majority of the Committee on Regulation of Motor Trucks renewed its recommendation of a 28,000-lb. allowable gross weight limit, in which the highway engineer members refused to concur. Prof. Arthur H. Blanchard, of the University of Michigan, was re-elected president of the association, and Elmer Thompson was re-elected secretary.

Uniform Signs

The committee report on uniform highway signs, presented by Mr. Thompson, advocated the placing of signs from 5 to 8 ft. above the road surface and the use of block letters at least 4 in. high. Signs should carry not only the name of the nearest town, but of the nearest important city. In New England experiments are being made with the use of luminous paint on highway signs to aid night traffic. The committee favors numerals for marking trunk line routes, a practice which has been approved throughout the New England States and which, the committee hopes, may be extended, by divisions, westward throughout the country.

In describing the New England marking work, Mr. Reed of the Automobile Club of America, explained that odd numbers are assigned to east and west routes and even numbers to north and south routes. The roads are marked by numbers in black on a yellow background and are in the form of painted squares on telegraph poles. Mr. Reed opposes the plan of color bands for highway marking. By resolution the National Highway Traffic Association approved the numeral scheme of marking as agreed upon in the New England states.

A report by Hirschel C. Smith, of the University of Michigan, chairman of the Committee on Traffic Capacity and Width of Highways, presented the following conclusions: Any two-lane roadway carrying intensive traffic should have a width of 20 ft. and 5-ft. shoulders for carrying standing vehicles during temporary delays. A two-lane roadway should be increased to a four-lane roadway when the traffic is reduced to the speed of the slowest vehicles if the economic loss of time will justify the expense. The building of three-lane roadways should be discouraged on the ground of danger to the traveling public.

Safety at Curves

Chief interest at the meeting centered in H. Eltinge Breed's report for the Committee on Highway Curves. Approval was given to ten recommendations as follows: (1) Banking on curves of more than 3 deg. varying from nothing for a 3-deg. curve to 1-in. per foot of width for curves of 20 deg. or sharper; (2) on curves of more than

(*Concluded on p. 930*)

Lumber Industry to Set Up Grade Standards

Producers and Users Favor National Standards and Guarantees to Protect Consumers

Resolutions favoring standardization of sizes and grades of lumber and nation-wide inspection and guarantees as to quality and quantity, together with concrete recommendations looking to these ends were adopted at a conference of lumber manufacturers and representatives of the principal lumber-using industries held in Washington during the last week at the instance of Secretary Hoover. The conference included producing and distributing lumbermen, representatives of the American Railway Association, American Electric Railway Association, wood-manufacturing industries, architects, and building engineers.

The final recommendation was "that all organizations representing producers, distributors and consumers of lumber be invited to appoint representatives to meet in a general conference on the call of the National Lumber Manufacturers' Association, with the assistance of the Departments of Commerce and Agriculture, for the purpose of arranging for holding meetings in as many sections of the United States as may be deemed necessary in order to arrive at definite recommendations concerning three subjects here under discussion, such recommendations to be placed before another general conference of all interests involved after the series of sectional conferences shall have been concluded." It is expected that the committee contemplated in this decision may be able to hold its first meeting within thirty days, and that a final conference may be held in the early fall to create the definite organization.

Committee Reports

The several committee reports approved by the conference, although representing the personal views of the committee members only, are considered to be in harmony with the views of the industry and it is expected that they will be ratified by the regional associations which compose the national association. The committee on names of grades recommended that the grading of all lumber be divided into three great subdivisions: A, representing the best qualities; B, representing the intermediate qualities; and C, representing the common qualities. The committee recommended that the National Lumber Manufacturers Association set up a competent committee with efficient engineering service to equalize grades in all woods.

The committee on standard sizes reported on the various items and sizes of stock on which agreement was reached, consideration having been given only such items as are manufactured in common by the various associations in which the finished sizes differ. The committee was not able to agree on the question of dimensions of 1-in. finish and common boards, S1 or 2 or 4 sides.

The committee on guarantee of quantity and quality held that the formulation of rules for grading and inspection is a function of the manufacturer and that grades should be made so as to allocate the available supply of timber to the various consuming industries in proportion to their needs. It recommended that the lumber industry as a whole provide for the manufacturers such inspection service and supervision as will guarantee quality to buyers. To accomplish this it urged that all grading be done by properly supervised inspectors, that in the case of complaint official association re-inspection be available, that buyers be furnished, at their own expense, certificates of inspection with each shipment, that a card be placed in each car specifying grade and content and that if found practicable an association, grade-mark be placed on a sufficient portion of each shipment to protect consumers, this mark to be such as to identify the producing mill.

Among those who participated in the conferences were Arthur T. Upson of the U. S. Forest Service; Albert T. Harris, of the American Institute of Architects; C. L. Warrick, president, and Herman von Schrenk, American Society for Testing Materials; Henry H. Snelling, American Society of Mechanical Engineers; W. H. Ham, American Society of Building Engineers; and R. B. Rayner, of the American Wholesale Lumber Association.

Electrical Engineers Elect

At the annual business meeting of the American Institute of Electrical Engineers held in New York City, May 19, F. B. Jewett, of New York, was elected president. The other officers elected were those named in *Engineering News-Record*, April 27, p. 700, as having been nominated to the respective positions which they now occupy.

Invitation to First Meeting of Construction Council

Lacking facilities at present for direct communication with the thousands of important men in the construction industry, the temporary directing committee of the American Construction Council begs leave through the columns of the engineering, architectural and construction press, to extend a personal invitation to each member of the industry to attend the organizing meeting in Washington, D. C., June 19 and 20.

The step contemplated, that of bringing together for co-operation in behalf of the industry and of the public all the elements of construction activity—engineers, architects, labor, contractors, manufacturers and dealers, and financial interests—is epochal in American industry. It deserves, and promises to have, the full support of the entire industry. A full representation at the organizing meeting will be the best testimony to the country of the desire for solidarity of construction interests.

Full details of the plan are set forth in a comprehensive pamphlet, procurable from the temporary office, 1053 Munsey Building, Washington. The meeting will be held in the Washington Hotel. Mr. Hoover will preside.

Temporary Directing Committee, American Construction Council, R. C. Marshall, Jr.

Pipe Break Floods Broadway

Flowing at a rate of 70,000,000 gal. per day water from a 36-in. cast-iron main of New York City's distribution system, which broke on the afternoon of May 29 at Broadway and 89th St., flooded streets and heaved up asphalt pavement at a number of nearby points. The main was located about 5 ft. below the street surface underneath a bank of ducts, the tops of which extended up close to the concrete base of the pavement. Department of Water Supply officials believe that the break may have been caused by the weight of heavy motor trucks transmitted to the water main through the overlying ducts.

Following a sudden drop in pressure at the 98th St. pumping station valves were closed at 92nd and 77th Streets. Emergency repair gangs were rushed to the scene and under the direction of William W. Brush, deputy chief engineer of the Water Department, the pipe was uncovered, disclosing a break in its side measuring about 60 x 30 in. The pipe was carrying about 45 lb. pressure and was part of the city's intermediate distribution service carrying both Catskill and Croton water. Repairs involved the taking out of the broken section and a half length of adjoining pipe and substituting new sections. The main was restored to service May 31.

Retain Supervising Engineer for Bridge on Salary

The New Jersey Highway Commission has disposed of a sharp public controversy over proper engineering charges in connection with the construction of a new highway bridge over Raritan River at Perth Amboy by retaining an engineer on salary "to supervise the design and construction." Clarence W. Hudson, consulting engineer, was engaged, the engagement to continue until completion of the structure. He will receive $18,000 per year, this sum not covering office and other expenses, which will be paid by the commission.

The original proposal before the commission was for an engineer to be retained at a fee of 6 per cent of the cost, the latter being estimated at $4,500,000. The crossing will include a draw span and involves foundations in soft ground about 100 to 125 ft. to rock.

New York Transit Company Must Run More Trains

Following up its announced purpose to improve the service rendered by existing rapid transit facilities in New York, the Transit Commission has issued two service orders to the Interborough Rapid Transit Co. One of these provides for an increase, effective May 31, of 246 trains per 24-hour period, and for lengthening of trains sufficient to increase by 2,014 the number of cars in service each day, together with a further increase, effective Sept. 18, of 114 trains per day. These increases will raise the total number of trains in operation daily from 2,773 to 3,133. It is estimated that the May schedule alone will effect an immediate increase of 20,935 car miles or 1,046,750 car seat miles per day. The second order directs the purchase of 350 new steel cars.

The Interborough Co. has accepted the orders and will abide by them.

Jury in Cement Trial Disagrees

(*Continued from p. 926*)

trade-practice expression of the keen competition that existed.

JUDGE'S CHARGE TO JURY

In charging the jury Judge Knox first reviewed the general propositions of the law governing the case, then read and explained the Sherman law indicating its specific application. As to the detailed consideration of the evidence he charged the jury that attendance at meetings of the protective association in itself was not incriminating; that participation alone in its activities, if it were a conspiracy, was a liability; that membership in either the Portland Cement Association or the Cement Manufacturers Protective Association did not constitute proof of knowledge that a conspiracy existed, if it actually did exist; that there were certain associations that did lawfully exist merely as clearing-houses for statistical and credit information; that the freight rate books, even with errors found in them, were lawful except as they may have been used as a means to price control; that uniformity of price might result from other causes than the existence of an express agreement, though such uniformity of price should be taken into account in weighing the whole evidence; that the good faith of the defendants in securing the advice of government officers in connection with their activities did not absolve them from blame if they actually did what they were charged with; and that shipments made by one mill for another had, on its face, no sinister meaning.

Judge Knox further charged the jury that the license agreement could not, in itself, convict the defendants, no matter how reprehensible their activities under that association might have been. He also said that the defense did not deny that there had been some trade restraint, but vigorously denied the existence of unreasonable restraint, which is made unlawful by the Sherman act.

As to the manner in which agreements to control prices are initiated Judge Knox said that conspirators rarely make express agreements. They are usually implied by some word, some act or some expression whereby the parties to the agreement understand what the terms of the conspiracy are to be. Even a meeting of minds under such circumstances constitutes a basis of guilt, he said.

In discussing trade practices Judge Knox asserted that some of them were innocuous. Discount rates, bin-test charges, charges for bags and bag-return allowances, and even a uniform price, might be harmless, he said, but if there was sufficient evidence to establish beyond any reasonable doubt an agreement was made to have a fixed price there was then constituted an unreasonable trade restraint.

In judging of the evidence he instructed the jury when trying to settle whether a conspiracy actually existed to determine, from the evidence, if the price had been excessive, if the production had been such that the price had been unreasonably controlled. "Individuals are free agents," he said, "and they can close their mills, ask any price they choose. All of the defendants might do the same lawfully, unless that simultaneous action is agreed to or done in concert."

Piepmeier Made State Highway Engineer of Missouri

B. H. Piepmeier, who has been appointed chief engineer of the Missouri State Highway Department to succeed Alexander Graham, resigned, is a native of Missouri but has been with the State Highway Department of Illinois for the past 14 years. He was born in Appleton City, Mo., in 1885, and was graduated from the engineering department of the University of Missouri in 1905.

For his first two years with the Illinois highway department he was in direct charge of road and bridge construction and in the next two years had supervision over the preparation of all road and bridge plans in the office. For two years he was district engineer for the southern half of Illinois and then held the position of road engineer for the department for two years, having general supervision over all road construction in the state. He was later made engineer of maintenance, in which position he organized a maintenance department and directed all details of the maintenance work.

During the past four years Mr. Piepmeier has been engineer of construction, with direct charge of all road and bridge construction done by the state. Since 1913, when he was made road engineer, the department has completed more than 1,400 miles of improved roads, besides a large number of bridges and considerable earthwork preparatory to future paving. The total money expended by Illinois for road building purposes since 1913 exceeds $30,000,000.

Mr. Piepmeier assumes his new position on June 1.

Dr. Elliott Is New Head of Purdue

Dr. Edward C. Elliott, chancellor of the University of Montana at Helena has been named president of Purdue University, Lafayette, Ind. He takes the place of Dr. W. E. Stone, who was killed last summer in a fall while on a mountain climbing trip in the Canadian Rockies. Henry W. Marshall has been acting as president of the university through his capacity as a member of the board of directors. Joseph E. Oliver, of South Bend, headed the committee of the trustees that obtained information concerning various educators and which has been working since shortly after the death of Dr. Stone. After months of inquiry they decided on Dr. Elliott. He was in a list of four men left as eligible.

Shipping Board Sells Lorain Housing Property

Sidney Henry, director of sales, U. S. Shipping Board Emergency Fleet Corp. has announced the sale, subject to the approval of the Shipping Board, of the Fleet Corp.'s housing property at Lorain, Ohio. The property for which a total of $543,250 has been realized, consists of approximately 43 acres, 232 dwellings, 2 store and apartment buildings. The houses are of frame construction with slate roofs. Total original cost was $1,940,000.

Lake Austin Dam Franchise Sold

All title, rights and interests in the Lake Austin dam franchise at Austin, Texas, were sold to a representative of the bondholders of the City Water Power Co. of Hartford, Conn., at auction held under a federal court order foreclosing against the franchise and property in every way connected with the dam. After the sale announcement was made that a new organization would be formed to complete the dam and deliver it to the city of Austin, since the result of the sale is that the title to the franchise and properties is cleared and goes into the hands of the bondholders of the company, which became bankrupt before the completion of the dam. This clears the way to the ultimate completion of the structure as specified in the contract between William D. Johnson, original contractor, and his assignee, the City Water Power Co.

Los Angeles Pays $12,044,370 for Electric Wire System

Negotiations for the purchase by the City of Los Angeles of that part of the electric light and power distribution system of the Southern California Edison Co. within the city limits were consummated May 16 and the city paid the company $12,044,370 for the property. The 120,000 consumers of the company will be supplied by the municipal Bureau of Power and Light, utilizing (1) current generated on the Los Angeles aqueduct and (2) current bought from the company. The city agrees not to sell current (1) outside of its present and future limits; (2) or the City of Pasadena; or (3) Inyo County. The company agrees not to sell domestic and industrial current within the territory named.

Landis Award Committee to Continue for Two Years

Terrorism and killing of police in Chicago over the labor situation has made the large committee to enforce the Landis Award decide to back the executive group's policy of non-recognition of the so-called outlaw unions to the end. For this purpose the committee has organized for a two-year campaign. The important significance of the decision lies in the fact that the jurisdiction of the Landis award expires in June, 1923, and there will then be a competent body to represent the public's interest.

At a meeting of the committee last week T. E. Donnelley, chairman, stated that the building industry was now free from graft, that the leadership of the Chicago Building Trades Council a year ago was worth $100,000 annually but now it is hard to find a man to take the job. Strikes have about ended, only three or four occurring this year and when the men quit the committee replaced them. The crime angle has prolonged the fight much longer than was at first expected and Mr. Donnelley pointed out that it would be fatal to stop activities prematurely. Numerous offers of compromise from the twelve outlaw unions placed on the open-shop list have been rejected.

Building permits taken out are setting a new record. The value for April was $17,076,560 compared with about $3,000,000 for April, 1921. For the first 17 days in May it was $14,571,800.

Local Court Upholds Error Claim in Columbus Dam Bid

The Court of Common Pleas of Franklin County, Ohio, has ordered returned to the Columbus Construction Co. its certified check for $100,000 submitted with its bid for the construction of the O'Shaughnessy dam for the water-works of Columbus, Ohio. The company, which was the lowest of 12 bidders for this work by $114,000 on April 20 declined to sign the contract which was awarded to it for the work, alleging that it had made errors totalling $73,500 in its bid computations (see *Engineering News-Record*, May 18, p. 845).

Traffic Measures Approved

(*Concluded from p. 927*)

4 deg. the pavement on the inside should be widened ½ ft. for each degree increase in curvature; (3) center-line marking on curves; (4) posting danger signs at a distance of 500 ft. from each end of curve; (5) legislation making it a misdemeanor for a motor vehicle to pass another going in the same direction on a curve, either horizontal or vertical, where unobstructed line of vision is less than 500 ft.; (6) minimum radius of curves to be 300 ft.; (7) earth slopes to be carried out at a 4-to-1 slope, otherwise a guide rail to be placed on inner edge of curve; (8) gravel or crushed stone shoulders 2 ft. wide and 4 in. deep on each side of the road, with application of hot tar or asphalt, if possible; (9) limitation of signs to those posted by official authority;—(10) inauguration by every state highway department of a definite plan with annual appropriations, for grade crossing elimination.

Truck Weights

The Committee on Regulation of Motor Trucks agreed upon all sections of its report, presented by George H. Pride, chairman, except the one making 28,000 lb. the allowable gross weight limit. The report recommended allowable limits of 96 in. for width, 12 ft. 6 in. for height, 30 ft. for length of one vehicle, 800 lb. pressure per inch width of tire and 22,000 lb. for load on one axle. Commissioner Synan, of the Massachusetts State Highway Department, took exception to the 28,000-lb. gross weight and said that Massachusetts was now engaged in a campaign to increase motor vehicle taxes and to reduce truck weights to 10 tons gross. Mr. Pride, arguing for the 28,000-lb. limit, pointed out that whereas highway construction and maintenance costs amount to millions annually, the operating costs of motor vehicle traffic run into the billions. Real economy, he believes, justifies the expenditure of considerable sums on highway improvement to carry trucks of great weight if transport costs can be thereby lowered.

Following the annual dinner of the association, addresses were made by Col. Arthur Woods, president of the Automobile Club of America; Prof. Blanchard on "The Railroad as an Operator of Highway Transport"; by F. W. Fenn of the National Automobile Chamber of Commerce, on "Highway Transport Franchises," and by Tom Snyder of Indianapolis, on "Highway Transport Clearing Houses"; and by Prof. W. K. Hatt on "Research."

Conservancy Act for Flood Control at Pueblo, Colo.

To provide adequate protection against such destructive floods as occurred in 1921 the city of Pueblo, Colo., needed the legal right to organize a flood-control district which could issue bonds for the necessary work. To meet this emergency a conservancy act has been passed by a special session of the state legislature. This law is modeled on that of the Miami Conservancy District in Ohio and as consulting engineer for flood-control work the city has retained Arthur E. Morgan, who planned and carried out the notable work of the Miami district.

The new law provides for the organization of conservancy districts for preventing floods, regulating stream channels, regulating the flow of streams, diverting and controlling water courses and protecting public and private property from inundation. Such a district may build reservoirs, canals, levees and other works, reclaim or fill lowlands and lands subject to overflow, and remove, regulate and prescribe the location of improvements upon land. It may also maintain, operate and repair any of the construction works.

A petition for a district must be signed by 200 landowners or a majority of the owners within the territory affected. It may be signed by the governing body of any public corporation, such as a municipality, and when so signed is binding on the owners of the land as they appear upon the tax rolls. Protest petitions may be signed by a majority of landowners and filed with the county clerk. An organized district becomes a political subdivision of the state. The district court has jurisdiction over a conservancy district and appoints three directors who are empowered to engage engineers. No power is given to operate irrigation systems or administer water rights. Three freeholders constitute a board of appraisers for the assessment of all benefits and damages, and for recommendations as to lands included. This board is subject to the approval of the court.

Three funds are provided for financing the undertaking: (1) the preliminary fund not to exceed one mill on the dollar from proceeds from a levelrate assessment; (2) a construction fund based on benefits as appraised; (3) a maintenance fund which is a special assessment levied annually and must not exceed 1 per cent of the appraised benefits of any one year.

Conservancy bonds may be issued in an amount not to exceed 90 per cent of the total construction fund assessment and money may be borrowed at not to exceed 7 per cent to facilitate the work.

Colorado Passes Moffat Tunnel and Pueblo Flood Bills

A law providing for the construction of the 6-mile Moffat tunnel on the Denver & Salt Lake Ry. by an assessment district to be organized on the same basis as drainage and irrigation districts was passed by the Colorado legislature on April 28. The house vote was 48 to 9 and the senate vote 28 to 3. Since the low-grade tunnel will be a great benefit to local commerce and industry, but the railway company cannot finance the project it has been decided to carry it out as a public improvement. A former plan to issue state bonds for the project was defeated by public vote (see *Engineering News-Record*, April 18 and Dec. 30, 1920, pp. 716 and 1,302). At the same session the legislature passed the bill for flood prevention works for the protection of the city of Pueblo, Col.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Salt Lake City, Utah, June 5-7.

NATIONAL CONFERENCE ON CITY PLANNING, Boston, Mass.; Annual Meeting, Springfield, Mass., June 5-7.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Convention, University of Illinois, June 20-23.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 26-30.

The Engineering Society of Akron, Ohio, had as its principal speaker at the May meeting Prof. Albert E. White of the University of Michigan, and his subject was "Responsibility of the Engineer, Our Colleges and the State of Research." Prof. White is director of the department of engineering research of the University of Michigan.

Personal Notes

JOHN J. CRIMMIN has resigned as general superintendent of the Chas. R. Hedden Co., Newark, N. J., and has accepted a similar position with the Kenneth Mackey & Co., Inc., general contractors of Yonkers, N. Y.

ALBERT O. TRUE, until recently special assistant engineer with the Pennsylvania State Department of Health, has been retained by the Proximity Manufacturing Co., Greensboro, N. C., as sanitary engineer.

WILLIAM E. STANLEY, for the past twenty months field engineer for Pearse, Greeley & Hansen, Chicago, in carge of the construction of the impounding dam for the additional water supply of Decatur, Ill., has been made assistant engineer in the Chicago office of that consulting hydraulic and sanitary engineering firm.

DR. HOWARD M. RAYMOND, for twenty-seven years dean of engineering of Armour Institute of Technology, has been appointed president of the Institute, succeeding the late Dr. Frank W. Gunsaulus, who died last year. Dr. Raymond has been serving as acting president since the death of Dr. Gun-

saulus. Dr. Raymond is a graduate of the University of Michigan.

EARL G. MARSH, who for the past seven years has been engaged in making surveys of proposed park extensions in Washington, D. C., has been appointed by the Secretary of War as superintendent of public parks of the District of Columbia.

J. C. NAGLE, dean of the engineering department of A. & M. College, Texas, has tendered his resignation to become effective September 1. Thereafter he will devote his time to consulting practice as a member of the Nagle, Witt, Rollins Engineering Co. During the summer, however, Dean Nagle will tour Europe where he will make a thorough study of engineering problems.

THOMAS TAYLOR, for the past ten years with the Department of Works, Toronto, Canada, principally as designing and construction engineer, was recently appointed engineer of railways and bridges of the Department of Works. Mr. Taylor was designer of the Bloor Street viaduct in Toronto.

WILLIAM HUGH COVERDALE, member of the firm of Coverdale & Colpitts, consulting engineers, New York City, has been appointed president of the Canada Steamship Lines, Ltd.

RALPH W. WYMER has been appointed sewage-disposal plant engineer at Barberton, Ohio. He succeeds E. B. PATTERSON who resigned recently.

JOHN D. WILLIAMS, who has been connected with the Indiana state government continuously since 1906, and whose most recent position has been chief clerk of the state highway department, has been named director of the highway department. Mr. Williams succeeds LAWRENCE LYONS, new Republican state chairman, whose resignation was handed to the commission May 16.

R. T. BROWN, chief field engineer, South Carolina Highway Department, has resigned and has entered the contracting business with J. T. PLOTT of Greensboro, N. C. Mr. Brown joined the highway department in 1917 and has successively held the positions of assistant highway engineer, chief of surveys and plans, and chief field engineer.

WILLIAM H. LEWIS has resigned as manager of the sluicing department Puget Sound Bridge and Dredging Co., Seattle, Wash., and has associated himself with W. C. MORSE, as hydraulic engineer and contractor, with offices in the Thompson Building, Seattle. Mr. Lewis was president of the Lewis-Wiley Co. which did the regrading work in Seattle and Portland. With Mr. Morse he originated the Lewis-Morse shearboard method of controlling material deposited by hydraulic sluicing, which was used in building Westover Terraces in Portland, the Ochoco Dam at Prineville, Ore., and the stadium for the University of Washington. The new firm will give special attention to sluicing work, to the application of wet methods in the transportation of earth and to the building of high and stable embankments.

W. F. JORDAN, principal assistant engineer of the New York Central R.R. Co., has been transferred from the Grand Central Terminal offices, New York City, to Albany. Among his other new duties Mr. Jordan will have supervision over the Hudson River Connecting R.R.

BUSINESS NOTES

CHICAGO ENGINEERING ASSOCIATES is the new name of an association of existing organizations to render engineering and construction service. James N. Hatch is chief engineer, and Edward N. Lake is general manager. The offices are in Chicago.

THE GUARANTEE CONSTRUCTION CO., New York City, announces the retirement of its former vice-president, W. G. Hudson. No other change has been made in the organization of the company.

THE MISSISSIPPI VALLEY STRUCTURAL STEEL CO. announces its formation by the merger of the Decatur Bridge Co., Decatur, Ill., and the Christopher & Simpson Iron Works Co., St. Louis, Mo. These two plants have a combined capacity of 40,000 tons annually. W. M. Wood, Decatur, Ill., is president of the company and C. R. Dick, secretary.

THE ASQUAM CONSTRUCTION CO., Toledo, Ohio, has been recently organized to engage in general construction and engineering. Incorporators are Theodore Tenscher, Leet J. Deibel, Manuel F. Felt, William Felt Tenscher and Charles W. Davis.

OBITUARY

WILLIAM G. CHARLESON, a contractor of Ottawa, Canada, died in Toronto May 18.

ARTHUR LAGRON, who was for a number of years the city engineer of Freeport, Ill., died recently in Peoria, Ill., aged 85 years. He was a native of France.

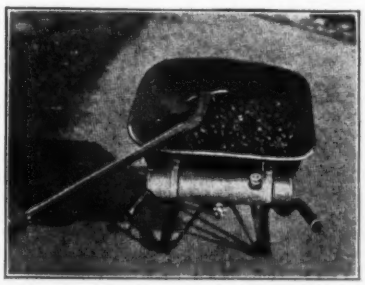
HENRY A. WATTERSON, contractor of Los Angeles, Cal., died recently in that city at the age of 76 years. Mr. Watterson's company had constructed several large engineering projects in and around Los Angeles, including the Hill Street tunnel.

GEORGE P. BRADISH, for the past fourteen years city engineer of La Crosse, Wis., died recently in that city very suddenly, aged 69 years. Mr. Bradish received his early education in La Crosse, later attending Lawrence College at Appleton, Wis., for one year. He then went to the University of Wisconsin from which institution he was graduated in civil engineering in 1876. After graduation he was employed by the Northwestern R.R. in construction work through the Dakotas, Minnesota, Nebraska, and other Western States. Mr. Bradish was appointed city engineer of La Crosse in June, 1907, upon the resignation of W. S. Woods.

EQUIPMENT AND MATERIALS

Heated Wheelbarrow for Bituminous Road Repair Materials

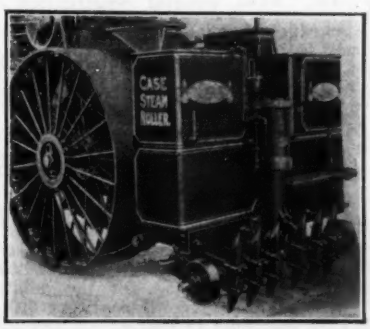
A gasoline-heated wheelbarrow for handling bituminous materials used in road repair work has been developed by the Road Repair Equipment Co., 165 Broadway, New York City. The wheelbarrow has a capacity of 3 cu.ft. and is equipped with a tank holding sufficient



gasoline for 10 hours continuous operation. The equipment is designed particularly for road patrol work and can also be employed for transporting roofing material, concrete in freezing weather, pipe jointing. Dumping of the barrow does not interfere with the operation of the heating device.

New Steam Scarifier

A new steam scarifier to be attached to a road roller has been announced by the J. I. Case T.M.Co., of Racine, Wis. The scarifier is attached to the rear of the roller and the same operator handles both. The additional weight of the complete attachment is about 1,850 lb. A steam pressure cylinder which is under instant control of the operator is employed to raise and lower the teeth by manipulating a four-way valve. The teeth are forced into the ground under a steam pressure of four tons and are



held there by a steam cushion. The picks can be raised or lowered in passing over cross walks, manhole covers and other immovable obstacles.

Six tool-steel scarifier teeth are used of 1½-in. x 2½-in. section and 22 in. long. The picks are adjustable for depth, and gage wheels prevent them from digging below the required depth in case the rear rolls drop into a hole in the road. The width of cut can be varied from 40 in. to 56 in. depending on the spacing of the picks, or any of the picks desired can be removed.

Business Side of Construction

Facts and Events that Affect Cost and Volume

May Contracts Reflect Business Revival

Increase of $63,105,640 Over Corresponding Period of 1921—Miscellaneous $4,160,916 Heavier

An increase of $63,105,640 in important engineering contracts in the United States during the month of May over the corresponding period of 1921, is indicative of the business revival of the country. Last month's contracts amounted to $172,010,171 in comparison to $108,904,531 in 1921, and $165,870,787 in 1920. These figures and those in Table I are compiled from Construction News, where minimum projects reach $25,000 each on public work and $150,000 in the case of commercial buildings.

Interesting to note, is the large gain in miscellaneous construction, which increased $4,160,916 over May, 1921, but fell $5,804,262 under 1920 figures.

Excavation and dredging was the only classification which in May, 1921, exceeded the value for the same month in 1922.

May's total value of contracts exceeds April contracts by $147,249,327, March contracts are $6,416,829 heavier than for May, and February contracts are $120,948,171 less than for the month of May. January contracts were $93,459,218 less than in May.

Business Briefs

Petroleum products are active, excepting kerosene, which is seasonably stagnant, market reports throughout the country say. Gasoline is in greatest demand and the tank-car price for it now has advanced to an average of 22 cents. Turpentine substitutes are firm and scarce.

Bituminous coal exports during April fell nearly 400,000 tons under March, according to the Department of Commerce. A total of 714,959 tons, valued at $3,479,041, were exported, compared with 1,187,313 tons, worth $6,311,540, in March and 1,443,091 tons, worth $9,135,379, in April, 1921.

Output of beehive coke in April dropped to 528,000 tons from 732,000 tons in March; by-product coke, on the other hand, increased 90,000 tons over March, with a total of 2,227,000 tons in April.

Crude oil production in the United States in the week ending May 13, is reported to have averaged 1,422,400 bbl. daily, according to statistics of the American Petroleum Institute. This is an increase of 14,950 bbl. daily, compared with the preceding week.

Automobile production in 1921 amounted to 1,668,550 vehicles, representing a total value of $1,260,000,000.

Labor Board Announces Cut in Railroad Wages

Maintenance-of-Way Labor Affected by Decision That Will Save More Than $48,000,000

Wage reductions affecting 400,000 railway employees and aggregating more than $48,000,000 are authorzied by a Railroad Labor Board decision announced May 28. Although these cuts apply mainly to maintenance-of-way employees decisions affecting other classes of labor are now pending.

The cuts authorized for the various classes of labor are as follows:

Bridge, building, painting, construction, mason and concrete, water supply and plumber foremen, except certain water supply and plumber foremen coming under the provisions of the cut authorized last July: decrease of 5 cents an hour.

Assistant bridge, building, painting, construction, mason and concrete, water supply and plumber foremen and coal wharf, coal chute and fence gang foremen, pile driver, ditching and hoisting engineers and bridge inspectors, except asssitant water-supply and plumber foremen coming under certain provisions of the cut of last July: decrease of 5 cents an hour.

Section, track and maintenance foremen and assistant section, track and maintenance foremen: decrease of 3 cents an hour.

Mechanics in the maintenance of way and bridge and building departments, except those that come within the scope of agreements with the federated shop crafts: decrease of 4 cents an hour.

Mechanics' helpers in the maintenance of way and bridges and building departments except those that come within the scope of agreements with the federated shop crafts: decrease of 1 cent an hour.

Track laborers and all common labor-

Engineering News-Record Construction Cost Index Number

June, 1922	166.62
May, 1922	164.62
June, 1921	209.82
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is two points higher than last month, due principally to a stiffening in labor rates. Demand for steel continues fair, but less urgent than recently, price for structurals unchanged at $1.60. Lumber generally higher. Cement advanced in the East, but is firm elsewhere. Average hourly rate for common labor is 43c. Thus, general construction cost is 21 per cent cheaper than one year ago and 39 per cent under the peak; it is 67 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
May, 1922	179
April, 1922	150
May, 1921	107
1913	100
Yearly	
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 179 for the month of April, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 179, for April, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES IN MAY, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total
Waterworks	$125,000	$482,000	$360,000	$959,000	$1,025,000	$617,000	$3,568,000
Sewers	.....	2,992,000	598,000	1,720,000	290,000	122,000	5,722,000
Bridges	26,000	5,674,000	636,000	379,000	1,153,000	50,000	7,920,000
Excavation and dredging	.....	.....	344,000	126,000	291,000	15,000	776,000
Streets and roads	1,759,000	16,609,000	4,864,000	10,794,000	5,043,000	3,215,000	42,284,000
Industrial works	3,865,000	5,826,000	425,000	2,539,000	162,000	1,001,000	13,818,000
Buildings	10,941,000	38,564,000	7,887,000	18,310,000	4,343,000	5,658,000	85,703,000
Fed. gov't. wks	106,000	645,000	1,291,000	.....	.....	1,327,000	3,369,00
Miscellaneous	172,000	4,669,000	743,000	502,000	1,246,950	1,064,000	8,396,950
Total	$16,996,000	$75,461,000	$17,148,000	$35,329,000	$13,553,950	$13,069,000	$171,556,950

ers in and around shops and roundhouses not otherwise provided for; decrease of 5 cents an hour.

Drawbridge tenders and assistants, piledriver, ditching and hoisting firemen, pumper engineers and pumpers, crossing watchmen or flagmen and lamplighters and tenders: decrease of 5 cents an hour.

Laborers employed in and around shops and roundhouses, such a engine watchmen and wipers, fire builders, ashpit men, flue borers, coal passers, except those coming under certain provisions of the decrease of last July, and coal chute men: decrease of 5 cents an hour.

Next Week—Production and Stocks of Materials Throughout the Country.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 273 to 284 are the following large projects:

A high school at Columbus, Ohio, $1,000,000.

A crypt at Washington, D. C., $5,000,000.

Elevation of grade crossings, St. Paul, Minn., $4,000,000.

University buildings at London, Ont., $1,000,000.

Coming — First five months of construction classified geographically and as to kind of work. Contracts let, bids desired, proposed. Construction News has reported contracts let worth $604,000,000 *with just as much coming along.*

Labor Rates and Conditions Throughout the Country

Steady and sustained gains in employment throughout the United States are shown in reports of the President's Conference on Unemployment. For every 100 jobs listed during April there were 150 applicants as against 182 in March; 205 in February and 226 in January. This represents a decrease of 33 per cent in the number of applicants for employment during the first four months of the year. Unemployment has decreased about 61 per cent since May 1, 1921, according to the National Industrial Conference Board.

Actual increases in rates are making their appearance in building trades wage schedules; due no doubt to increasing shortage of skilled mechanics. For example, carpenters in Pittsburgh and bricklayers in Detroit have been granted an increase of 12½c. per hr., effective June 1. No wage decreases for skilled labor are noted in twenty-one cities reporting to *Engineering News-Record*, though slight reductions and adjustments are reported for common labor in New York and Minneapolis.

With the 1921 wage scale still in effect in New York City and premium wages being offered many of the skilled building trades, the unskilled rates seem to range between 44c. and 60c. per hr., which is considerably below the 1921 schedule. This is plainly an instance of cutting under the established rate for union common labor and applies to conditions such as those existing in reinforced-concrete construction.

New Orleans' present wage scale expires June 15. No negotiations, known to the public, are pending between men and employers, although plumbers are reported to have accepted the new schedule of 90c per hr., effective June 15. Unemployment has diminished 55½ per cent this year; there are 4,000 unemployed men in *New Orleans* as against 9,000 in December, 1921. Heavy rains, flooding the lumber camps, have thrown many out of unemployment in the timber section. Day laborers receive as low as $1.50 per day; mechanics demand $5.

The largest industrial concern in the *Birmingham* district has increased the coal miners' wage rate 10 per cent and that for ore miners 15 per cent, effective May 15. Wage rates in other trades remain unchanged.

Pittsburgh reports hoisting engineers, hod-carriers and common laborers plentiful, but there are just enough bricklayers and structural ironworkers to meet the demand. Carpenters are scarce and many are coming in from out of town.

Conditions in all trades have about reached normal in *Detroit*, with supply equal to the demand. The Associated Building Employers have arranged to open an employment bureau which will be operated on the American plan.

Very little unemployment in *Los Angeles*. Normal supply of bricklayers; other skilled building trades are operating under fairly satisfactory conditions. Common labor situation improving gradually; present conditions much better than a month ago.

Apartment house and residence building continues to be the feature of construction in *Atlanta*. Labor is in good demand and available at the lowest wage rates prevailing in any of the twenty American cities reporting. Hod-carriers, however, are obtained at a slightly lower rate in *Birmingham*, at 15c.@25c. as against 30c. in *Atlanta*.

No unemployment among bricklayers, carpenters or hod-carriers in *Denver*. Large increase in employment of piledrivers, structural ironworkers and common laborers.

Labor plentiful in *Montreal* and *Minneapolis;* no unemployment among building trades mechanics in the latter.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$0.70	$0.30	.....	$0.65	$0.20
Baltimore	1.25	.80	.87	.54	$0.74	1.00	.30
Birmingham	1.00	.75	.50@1.00	.15@.25	.....	1.00	.15@20
Boston	.90	.90	.90	.60	.90	.90	.55
Cincinnati	1.25	.95	.95	.72½	.77½	.95	.40
Chicago	1.10	1.00	1.10	.....	1.10	1.05	.72½
Cleveland	+1.25	+1.04@1.10	1.04	.60	.91	+1.10	.57½
Dallas	1.00	1.00	1.00	.60	1.00	1.00	.25
Denver	1.25	1.00	1.00	.75@.81½	1.00	1.03½	.35@.50
Detroit	+1.12½	.80	.80@.90	50@.60	1.00	.60@.80	.50
Kansas City	1.07½	1.00	1.00	.80	1.07½	1.07½	.....
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.56½@.62½
Minneapolis	1.00	.80	.80	.65	.....	.80	—.35@.50
Montreal	.80	.60	.50	.35	.50	.55	.20@30
New Orleans	1.00	.88	.90	.40	.80	1.00	.30
New York	1.25	1.12½	1.25	.87½	1.00	1.12½	—.44@.60
Pittsburgh	1.30	+1.12½	1.00	.80	1.00	1.00	.35@.60
St. Louis	1.25	1.12½	1.12½	.85	1.00	1.05	.35@.40
San Francisco	1.12½	1.00	1.00	.75	1.00	1.12½	47½@.50
Seattle	1.00	.80	.90	.70	1.00	.80@.90	.50@.60
Philadelphia	1.00	.90	.90	.75@90	1.00	.90	.25@.35

$250,000,000 To Be Saved by Freight Rate Cut

By H. M. Cunnington

That the effect of the order by the Interstate Commerce Commission for a general 10 per cent reduction in freight rates, effective July 1, will be an annual saving to shippers of from $200,000,000 to $250,000,000, is the opinion of many traffic experts throughout the country.

Railway officials compute that compared with the rates effective after the last increases, in August, 1920, the reduction is approximately $450,000,000. Since then, there have been various reductions, some voluntary, some ordered, equivalent to perhaps, $200,000,000, these reductions including those on Southern hardwood. In railway opinion, the net reduction, below the return from existing rates, caused by the 10 per cent rate reduction of last week, is $250,000,000.

Slight effect on Stock Exchange prices has been noted. It is significant that railway stocks have not advanced with the general list in this season's rise. Further explanation of the philosophy with which the freight cut has been received lies in the fact that most railway men have felt that the rate advance of 25 and 40 per cent in August, 1920, was too heavy for the traffic to bear.

The cut in freight rates, horizontal instead of on specified commodities, is the first general reduction since the period of government control. By territorial groups, the commission's proposed new rates are as follows:

In the eastern group, including Illinois, 26 per cent above rates effective before August, 1920, instead of the 40 per cent increase effective since then.

In the western district, and between it and Illinois, 21.5 per cent above 1920, instead of the 35 per cent authorized since then.

In the southern and mountain Pacific groups, 12.5 per cent above 1920, instead of the 25 per cent authorized then.

On territorial traffic, 20 per cent above 1920, instead of the 33⅓ per cent authorized then.

The railroads have until May 31 to determine whether they intend to contest the order. Not a representative of the railway executives has commented on any such action. It is said that the executives want to give full study to the decision and all its angles.

The Interstate Commerce Commission, officials of that body say, acted in the conviction that modification of the transportation rate level would encourage resumption of normal traffic and stabilize the conditions governing commerce and industry, contributing to business revival. That the railroads can stand the decrease is the conviction of the Commission, notwithstanding the argument and evidence to the contrary submitted by the carriers.

"We are of opinion," says the report of the Commission, "that general reduction in the rate level, as substantial as the condition of the carriers will permit, will tend not only to lessen the transportation burden, but also to equalize and stabilize the conditions under which commerce and industry are carried on, with consequent fuller assurance to the carriers of realizing the fair return contemplated by the law."

Freight Loadings Increase 28 per Cent in Week

In the week ending May 13, 1922, the total revenue freight loaded was 777,359 cars, an increase over the week of May 6 far in excess of the decline suffered in that week from the week of April 29. Every classification participated in this advance save live stock and merchandise, l.c.l., wherein the decreases were not, however, marked. Coal and coke, despite the effect of the sixth complete week of the miners' strike, both showed a good gain, while the ore loading climbed back to the record of the second week preceding. The miscellaneous loading jumped 10,933 cars —an indication that the miners' strike has not as yet adversely affected general business. Compared with the preceding year, the 1922 performance was an increase of 26,173 cars, a comparison which indicates the extraordinary depression which business was under a year ago. The decrease compared with the same week of 1920, when business was booming, was 65,786. The serviceable surplus of freight cars for the week ended May 15, 1922, was 343,689, a decrease of 9,550 compared with the week ending May 8. The box surplus was 84,640, the decrease over the previous week being 1,964. The coal car surplus was 218,466, or 7,810 fewer.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—No. 2 Foundry iron up $1 in Birmingham; No. 2 Foundry Southern advanced $8 in Chicago. Advances $2 to $5 per gross ton at other principal furnaces. Coke production in Connellsville district gained 6 per cent during third week of May. Much imported pig iron being used.

Railway Supplies—Light rails quoted at $30@$32 as against $30 per ton, f.o.b. Pittsburgh; standard spikes quoted at a minimum of $2.25 per 100 lb. at mill. Spikes and track bolts up 10c. per 100 lb. in Birmingham. Railroad buying of freight car materials and rails continues a trifle heavier than the pre-war rate.

Pipe—Continued rise in pig iron reflected in cast-iron pipe which advances $1 in San Francisco and $2 per ton in New York. Sewer pipe advanced 1c. per ft. in Birmingham and Atlanta. Rise in Pittsburgh on standard sewer pipe in sizes above 24-in. Chicago, Minneapolis, Philadelphia, Cincinnati and Detroit quotations based upon double strength sewers.

Road and Paving Materials—Asphalt, in bulk, $21.35 as against $19.95 per ton, in Minneapolis. Granite paving blocks, 5-in., $131.75 delivered in New York as against $130 per 1,000; Montreal quotes $100 as as compared with $125 per 1,000 last month. Wood blocks up 30c. in Philadelphia and down 4c. per sq.yd. in Minneapolis.

Sand, Gravel and Crushed Stone—Prices very firm throughout the country, in view of constantly increasing volume of construction.

Lime—Hydrated finishing lime in Atlanta $22.50 as against $18; hydrated common, $13 as compared with $12.50 per ton, one month ago; common lump lime up 50c. per bbl., 180-lb. net. Hydrated common lime up 50c. in Philadelphia and down 50c. per ton Boston.

Cement—New York quotes $2.40@$2.50 as against $2.40, delivered, without bags and $2.10 as compared with $2 per bbl., alongside dock to dealers. Price in San Francisco $2.83 as against $2.73. Drop of 2c. per bbl. in Milwaukee and Montreal and 5c. in Atlanta. Mill advances, owing to coal situation, of 10c. at Hudson, N. Y., and 20c. per bbl. at Northampton, Pa.

Structural Material—High fuel costs coupled with possibilities of labor shortage and higher wages, as well as shorter working hours, hold price firm at $1.60 per 100 lb., f.o.b. mill. Steel bars, however, show upward tendency. Structural rivets, ¾-in., quoted at minimum of $2.25 and cone-heads, ¾-in., at $2.35, Pittsburgh. Steel sheets firm at mill but up 10c. per 100 lb. at New York warehouses.

Brick and Hollow Tile—Common brick, New York, $20 per 1,000 wholesale, alongside dock, as aganist $17; $23.50 delivered as compared with $20.40 per 1,000, one month ago. Shortage continues. Atlanta quotes rise of $1; Minneapolis, $1@$2, and Birmingham, $2 per 1,000. Slight rise in hollow tile in Chicago, Minneapolis, Birmingham and Pittsburgh; down in Montreal.

Lumber—Long-leaf yellow pine, base sizes, up $3@$6 in Chicago; stable in New York. Increased demand has forced lumber prices upward, $1@$5 per M. ft. in more than a dozen important cities in the United States. Declines reported in Montreal.

Scrap—Stove plate and rails for rerolling rise 50c. per gross ton in New York; scrap prices otherwise firm.

Manila Rope—Prices up 1c. in Philadelphia and ½c. per lb. in New Orleans for ¾-in. rope.

Explosives—Decline of 2c. in 40 per cent and 3c. in 60 per cent gelatin dynamite in Los Angeles; 60 per cent gelatin down ½c. per lb. in Atlanta.

Linseed Oil—Raw linseed oil quoted at $1.03 as against 90c. per gal. (5-bbl. lots) in Chicago, one month ago. Prices farily stable elsewhere throughout the country.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	**$25.52**	$28.75
Northern Basic	**25.02†**	26.52
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	**22.50†**	27.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	**28.56†**	34.26
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	**17.50†**	24.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	**26.36†**	26.26*
Virginia No. 2 (silicon 2.25 @ 2.75)	**28.34†**	27.00*
Basic	**23.50@25.50†**	25.00†
Grey Forge	**25.00†**	25.00*
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	**23.50†**	23.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	**24.17†**	29.67
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	**24.16†**	26.46
Basic	**25.00†**	28.46
Bessemer	**26.96†**	26.96

*F.o.b. furnace. † Delivered.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh			
	Current	One Year Ago	Birmingham	Chicago
Standard bessemer rails	$40.00	$45.00	.....	$40.00
Standard openhearth rails	40.00	47.00	$40.00	40.00
Light rails, 8 to 10 lb	30@32	2.30*	1.60*	1.60@1.70*
Light rails, 12 to 14 lb	30@32	2.25*	1.60*	1.60@1.70*
Light rails, 25 to 45 lb	30@32	2.20*	1.60*	1.60@1.70*
Rerolled Rails	28.00	.....	.....	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.35	$1.50
Chicago, Hardwood and Red Oak	1.20	1.30
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco..... Green Douglas Fir	.85	1.10
San Francisco, Empty Cell Creosoted, Douglas Fir	1.86	2.30
St. Louis, White Oak*	1.10	1.44
St. Louis, Red Oak*	.97	1.17
St. Louis (creosoted)	No. 1, $0.86;	No. 2, $0.96; No. 4, $1.28

*Standard specifications 38c. per tie additional. Zinc chloride process 27c. per tie additional.

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	Current	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅜-in. and larger	$2.25	$3.30	$2.55	$3.00	*$4.10*	**$3.20**
Track bolts	3.00@3.50	4.35	3.65	4.25	*5.10*	**4.15**
Standard section angle bars	2.40	2.50	2.40	3.00	4.00	3.25

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	71	58½	¼ to 1¼	44½	29½

LAP WELD

2	64	51½	2	39½	25½
2½ to 6	68	55½	2½ to 6	42½	29½
7 to 8	65	51½	7 to 12	40½	27½
9 to 12	64	50½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

¼ to 1¼	69	57½	¼ to 1¼	44½	30½
2 to 3	70	58½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	62	50½	2	40½	27½
2½ to 4	66	54½	2½ to 4	43½	31½
4½ to 6	65	53½	4½ to 6	42½	30½
7 to 8	61	47½	7 to 8	35½	23½
9 to 12	55	41½	9 to 12	30½	18½

STEEL—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
¼ to 3 in. butt welded	66%	62½%	59%
2½ to 6 in. lap welded	61%	59½%	56%

	Galvanized		
	New York	Chicago	St. Louis
¼ to 3 in. butt welded	53%	48½%	45%
2½ to 6 in. lap welded	47%	45½%	42%

Malleable fittings, Class B and C, from New York stock sell at list less 10%. Cast iron, standard sizes, *32-5%* off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York One Year Ago	New York Current	Chicago	St. Louis	San Francisco
4 in.	$38.50	**$51.80**	$68.30	48.10@48.60	$43.70	**$55.00**
6 in. and over	34.50	**48.80@49.80**	58.30	44.10	39.70	**51.00**

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$40.00	$50.00	.....	$50.00	.....	$55.00
4	50.00	60.00	$80.00	60.00	$76.50	65.00
5	80.00	90.00	.....	80.00	97.75	84.00
6	100.00	115.00	140.00	100.00	127.50	110.00
8	150.00	185.00	200.00	150.00	212.50	181.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0.14	$0.087	.....	.....	$0.12	$0.12	.....
4	.14	.087	**$0.09**	$0.0875	.12	.15	**$0.18**
5	.21	.1305	**.1125**	.....	.18	.18	.165
6	.21	.1305	**.135**	.1225	.18	.21	.25
8	.35	.203	**.225**	.20	.28	.30	.35
10	.52	.3045	**.2925**	.28	.42	.42	.....
12	.67	.3915	**.3825**	.36	.54	.54	**.80**
15	1.15†	.522	**.5625**	.52	.72	.90	.....
18	1.55†	.725	**.765**	.68	1.00	1.32	.....
20	1.98†	.87	.....	.92	1.20	.....	.....
22	2.64†	1.16	.....	.....	1.60	.....	.....
24	2.97†	1.305	**1.50**	1.20	1.80	2.16	**2.40**
27	**4.50†**	**2.34**	.....	2.00	3.75†	3.00	.....
30	**5.00†**	**2.59**	.....	2.45	4.75†	3.60	.....
33	**6.55†**	**3.51**	.....	3.00	5.50†	.....	.....
36	**7.50†**	**4.00**	.....	3.25	6.00†	.....	.....

	3	5	8	12	24	36
Boston	**$0.105**	**$0.1575**	**$0.245**	$0.4725	$1.575	$4.408
Minneapolis	.....	.....	.40	.77	2.55	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.13	.....	.32½	.65†‖	2.34†	.....
Los Angeles	.11*	.165*	**.275**	.495	1.65	.....
New Orleans	.....	.106	**.27**	**.459**	1.755	.....
Cincinnati	.096	.144	.224	.43	1.44	4.382†
Atlanta	**.085***	**.1275***	**.21**	**.355**	**1.37**	.....
Montreal, *delivered*	.30*	.45*	.70*	1.35	4.50	.....
Detroit	.099	.1485	.231	.4455	1.935	5.125†
Baltimore	.1225	.2275	.35	.6870	**2.29**	**5.23**
Kansas City, Mo	.15*	.21*	.335	.60	**2.41**	4.74
Philadelphia	.105	.1575	.245	.4725	1.575	3.5875†

*4-in., 6-in., 9-in., respectively. †Double Strength.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

		Current	One Year Ago
New York, 45% asphalt	(at terminal)	$0.05	$0.06½
New York, 65% asphalt	(at terminal)	.045	.06
New York, binder	(at terminal)	.055	.07
New York, flux	(at terminal)	.05	.06½
New York, liquid asphalt	(at terminal)	.06	.08
St. Louis, 30-50% asphalt	(*f.o.b.*) *Wood River, Ill.*	**.05**	**.02½***
Chicago, 40-50% asphalt		.05	.06
Chicago, 60-70% asphalt		**.05½**	**.06½**
Dallas, 40-50% asphalt		.10	.10
Dallas, 60-70% asphalt		.13	.13
Dallas, 75-90% asphalt		.15	.15
San Francisco, binder, per ton		**13.00†**	**15.00**

* Freight $21.75 per ton to Whiting, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots:

	Package	Bulk
New York (Bayonne, N. J.)	$25.00	$15.00
Boston	No quotations	
Chicago	24.35	18.0
San Francisco. *f.o.b. refinery*, Oleum, Cal. (natural)	19.50*	13.50*
Dallas	35.00	27.00
Seattle *"D" grade*	23.75	27.25†
Denver	40.00	
Minneapolis *f.o.b. Twin Cities*		21.35
St. Louis (natural)	22.35	14.00
Baltimore	25.00	20.00
Los Angeles, *at factory*	22.50	15.00
Montreal	28.00	21.00
Atlanta	28.00	
Detroit (petroleum asphalt)	25.00	19.00
Cincinnati	32.00	28.00
Maurer, N. J. (natural asphalt)	36.00	33.00
Maurer, N. J. (artificial asphalt)	22.00	20.00
Philadelphia	24.00	17.50
Kansas City	28.83	22.83

*Freight to San Francisco, 80c. per ton.

†Petrolastic XX.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

PAVING STONE—

New York *delivered*	5-in. granite, 28@29 blocks per sq.yd.	$131.75	per M
Chicago	About 4x8x4 dressed	3.20	sq.yd.
	About 4x8x4 common	3.00	sq.yd.
San Francisco	Basalt block 4x7x8	70.00	per M
Boston	5-in. granite	125.00	per M
Atlanta	Granite	2.00	sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	3.05	sq.yd.
Baltimore	Granite	2.00	sq.yd.
Montreal	Granite	*100.00*	per M
New Orleans	Granite, 4 x 8 x 4	3.25	sq.yd.
Cincinnati	Granite	3.84@4	sq.yd.
St. Louis	4x8x4 dressed	3.35	sq.yd.
	4x8x4 common	3.00	sq.yd.
Kansas City	No. Granite	3.95	sq.yd.
Philadelphia	Granite	125.00	per M.

FLAGGING—

New York	Bronx	$0.25	sq.ft.
	Manhattan, 4 ft.	.26	sq.ft.
	Queens, 5 ft.	.26	sq.ft.
	6x20-in. cross-walk	1.00	lin.ft.
Chicago	18 in. wide	.99	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in.; in cargo lots.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.04
New York (*delivered*)	3½	16	2.17
New York (*delivered*)	4	16	2.36
Boston	3	16	2.17
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50@2.75
St. Louis	3½	16	2.50
St. Louis	4	16	3.00
Seattle	4	16	Off market
Minneapolis	3½	16	*2.09*
Atlanta	3½	16	2.30
New Orleans	3	16	1.60
New Orleans	3½	16	1.80
New Orleans	4	16	2.00
Dallas	4	18	3.90
Baltimore	3½	16	3.44
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	2.10
Kansas City	4	16	2.15
Philadelphia	3½	16	3.80

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$1.75	$2.50	$1.75	$2.50	$1.00	$1.25
Denver	2.50	2.00	2.50	1.80	1.10	1.60
Chicago	1.80	2.25	1.80	2.25	1.80	2.25
St. Louis, *per ton*	1.25	1.55	1.30	1.60	1.10	1.60*
Seattle	*1.25*	1.50	*1.25*	1.50	*1.25*	1.50
Dallas	2.25	3.50	2.25	4.00	2.25	3.00
Minneapolis	1.50	2.00	1.50	....	1.00	1.00
Cincinnati	1.87½	2.36	1.87½	2.36	1.43	1.86
San Francisco	2.25	2.25	2.25	2.25	1.50	1.50
Boston	2.40	2.65	2.40	2.65	1.65	2.00
New Orleans	2.08½	2.85	2.08½	....	1.35	1.65
Los Angeles, per ton	1.50†	1.45†	1.50†	1.45†	1.35†	1.30†
Atlanta, per ton	1.85	2.80	1.85	....	1.15	1.62½
Detroit	2.00	2.50	2.00	2.50	2.00	2.50
Baltimore, per ton	1.40	1.40	1.60	1.60	2.00	.70
Montreal, per ton	1.25	1.50	1.50	1.50	1.25	1.25
Birmingham, per ton (Crushed slag used instead of gravel)					1.25	1.43‡
Philadelphia	1.50	....	1.55	....	1.60	....
Kansas City	2.00	3.25	2.00	3.75	1.20	1.25

* Fine white sand: Pacific, $5 per ton; Ottawa, $6.

† Freight from quarry to Los Angeles is 85c. per ton, and is included in above price.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1.65	$1.90@2.00	$1.75	$2.15
Chicago	1.60	2.50	1.60	2.50
St. Louis *delivered*	1.65	2.60*	1.65	2.60*
Dallas, *delivered*	2.73	2.80	2.73	2.80
San Francisco	2.25	2.25	2.25	2.25
Boston, *delivered*	3.00*	3.00* (del.)	3.00*	3.00* (del.)
Minneapolis, *at plant*	2.00	2.00	2.25	2.25
Kansas City, *at plant*	2.10	1.25	2.10	1.40
Denver	3.50		3.50	
Seattle *delivered*	3.00	3.50 (del.)	3.00	3.50 (del.)
Atlanta	1.90*	2.50*	1.90*	
Cincinnati *delivered*	1.75	3.24	1.75	3.24
Los Angeles	1.75*	1.70*	1.85*	1.80*
Detroit	1.90*	2.00*	1.90*	2.00*
Baltimore	1.75*	1.75*	1.65*	1.75*
Montreal	2.00*	2.00*	*1.60**	2.10*
Birmingham *delivered*	3.20	....	3.10	....
Phildelphia	1.70*	....	1.55*	....
Pittsburgh	2.85	....	2.85	....
Cleveland	*3.00**	....	*3.00**	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Emporium, Pa	1.25	1.25	....	1.25
Easton, Catasaqua, Pa	1.00	1.00	2.00	0.90
Birmingham, Ala	*0.90*	*1.00*	....	*0.40*
Buffalo, N. Y., and Erie, Pa	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20	....	1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$15.80@$16.80	$12.50	$3.68*	$2.75@$3.18*
Chicago	18.00	....	....	1.40†
St. Louis	23.20	20.00	2.35†	....
Boston	23.00	*19.00*	3.30†	3.00†
Dallas	25.00	....	....	2.50†
Cincinnati	15.10	12.50	10.75‡	12.50‡
San Francisco	22.00	18.00	....	1.75†
Minneapolis	29.00	22.00 (white)	1.70†	1.40†
Denver	24.00	....	....	2.70†
Detroit	18.00	16.00	....	17.00‡
Seattle *paper sacks*	*24.00*	....	2.80†	....
Los Angeles	30.00	30.00	3.00*	3.00*
Baltimore	15.00	13.00	....	12.00‡
Montreal	21.00	21.00	15.00‡	11.00‡
Atlanta	22.50	13.00	2.00†	1.75†
New Orleans	....	17.25	1.75†	....
Philadelphia	13.00	12.00	10.50‡	9.50‡

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.70, Sheboygan $1.55. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.60	1.60
Atlanta (Magnolia)	11.00 ton	11.00
Cincinnati (Utica)	1.77	2.75
Boston (Rosendale) per bag	.80	3.00
St. Louis (Carney hydrated)	2.10	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b points listed *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York, del. by truck	$2.40@2.50	$2.40	$2.80
New York, alongside dock to dealers	2.10	2.00	2.40
Jersey City, del. by truck	2.32	2.12	2.89
Boston	2.50	2.50	2.86
Chicago	1.97	1.97	2.17
Pittsburgh	2.02	2.02	2.17
Cleveland	2.26	2.26	2.43
Detroit	2.17	2.17	2.43
Indianapolis	2.21	2.21	2.43
Toledo	2.20	2.20	2.49
Milwaukee	*2.16*	2.18	2.39
Duluth	1.94	1.94	2.10
Peoria	2.08	2.08	2.45
Cedar Rapids	2.21	2.21	2.51
Davenport	*2.14*	2.16	2.47
St. Louis	2.20	2.20	2.60
San Francisco	2.83	2.73	3.09
New Orleans	3.00	3.00	3.36
Minneapolis	2.24	2.24	2.41
Denver	2.90	2.90	3.10
Seattle	2.94	2.94	3.10
Dallas	2.25	2.25	2.60
Atlanta	*2.34*	2.39	2.80
Cincinnati	2.35	2.35	2.57
Los Angeles	3.30	3.30	3.21
Baltimore, del. by truck	2.50	2.50	3.58
Birmingham	2.27	2.27	3.05
Kansas City	2.40	2.40	2.55
Montreal	*2.48*	2.50	3.44
Philadelphia	2.21	2.21	....
St. Paul	2.24	2.24	2.41

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags; to contractors:

Buffington, Ind	$1.70	Mason City, Ia	$1.95
Universal, Pa	1.75	Hudson, N. Y	2.00
Steelton, Minn	1.75	Leeds, Ala	1.85
Fordwick, Va	1.95	Hannibal, Mo	1.85
Mitchell, Ind	1.95	Lehigh Valley District	1.90
LaSalle, Ill	1.70	Kingsport, Tenn	1.95
Iola, Kan	1.95	Richard City, Tenn	1.95

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse: New York	Chicago	Dallas	San Francisco
032	22	$0.68	$0.95	$0.76	$1.15	$1.15
049	28	.87	1.23	98	1.46	1.48
068	35	1.05	1.48	1.18	1.80	1.80
093	45	1.35	1.91	1.52	2.30	2.32
126	57	1.65	2.35	1.87	2.86	2.87
153	68	1.97	2.81	2.23	3.40	.....
180	78	2.26	3.22	2.56	3.93	.....
245	103	2.99	4.25	3.38	5.15	.....
287	119	3.45	4.90	3.90	5.96	6.01
336	138	4.00	5.69	4.52	7.32	.....
395	160	4.64	6.60	5.20	8.00	.....
		PAVING				
036P	17	$0.52	$0.72	$0.58	$0.88	.....
053P	24	.73	1.02	.82	1.24	.....
072P	31	.91	1.29	1.00	1.57	.....
097P	40	1.18	1.67	1.29	2.02	.....
049R	24	.73	1.02	.67	1.24	.....
067R	31	.91	1.29	1.00	1.57	.....
089R	40	1.18	1.67	1.29	2.02	.....

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27BB	2.3	$21.20	$20.39	$21.25	$23.87	$25.50
26BB	2.5	22.65	22.00	22.75	26.21	27.56
25BB	3.0	25.30	.....	27.10	.....	30.71
24BB	3.4	27.10	26.33	29.25	27.90	33.16
22PO	4.33	31.75	31.00	31.75	.....	35.10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$1.60	$1.75	$2.48	$2.38	$2.47½	$3.50	$2.55
⅝ and larger	1.65	1.80	2.53	2.43	2.52½	3.55	2.60
¾ and larger	1.70	1.80	2.58	2.48	2.57½	3.60	2.65
⅞ and larger	1.85	1.85	2.63	2.63	2.72½	3.75	2.80
1 and larger	2.10	1.85	2.68	2.88	2.97½	4.00	3.05

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	$1.60	$2.25	$3.25	½.....	$1.85	$2.50	$3.50
⅝ in.....	1.65	2.30	3.30	¾.....	2.10	2.75	3.75
⅞.....	1.70	2.35	3.35	1.....	.....	.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current*	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.).....	23.50	$20.40	$18.40	$44.50†	$49.50†
New York (at dock)...	20.00	17.00	14@15	.....	.....
Chicago.....	11.00	11.00	12.00	34.00	42.00
St. Louis, salmon.....	14.00	14.00	15.00	.....	28.00
Denver, salmon.....	12.00	12.00	14.00	.....	.....
Dallas.....	11.15	11.15	15.00	no market	
San Francisco.....	15.00	15.00	18.00	.....	.....
Los Angeles (del.).....	15.00	15.00	15.50	(not used)	
Boston (del.).....	16.00	16.00	21.00	46.50†	52.60†
Minneapolis (del.).....	16@17	15.00	17@18	.....	43.00
Kansas City.....	14.50	14.50	17.50	.....	.....
Seattle.....	14.00	14.00	19.00	44.00	.....
Cincinnati.....	15.00	15.00	19.00	41.00	36.50
Montreal (del.).....	16.00	16.00	18.00	.....	68.00
Detroit (del.).....	16.50	16.50	17.50	36.50	39.50
Baltimore (del.).....	20.00	20.00	25.00	36.00‡	.....
Atlanta.....	10.00	9.00	12.50	.....	.....
New Orleans.....	12.50	12.50	14.50	.....	.....
Birmingham.....	11.50	9.50	.....	.....	.....
Philadelphia.....	16.50@17.50	16.00	.....	.....	42.00
Pittsburgh (del.).....	16.00	17.50	.....	.....	.....

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡ Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Current on Trucks*	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12...	$0.1120	$0.1196	$0.0707	$0.095	$0.0635	$0.108	.....
6x12x12...	.16670	.1345	.0973	.....	.08	.156	.....
8x12x12...	.20840	.1794	.1326	.175	.12	.244	$0.17890
10x12x12...	.....	.2392	.1621	.....	.16	.....	.21050
12x12x12...	.....	.3587	.1853	.....	.185	.....	.27370

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston.....	$0.94	$0.177	$0.244
Minneapolis (f.o.b. cars).....	.072	.11875	.210
Minneapolis (delivered).....	.082	.13425	.235
Cincinnati.....	.0670	.1263	.175
Kansas City.....	.085	.167	.270
Denver.....	.08	.145	.21
Seattle (delivered).....	.12	.25	.30
Los Angeles factory.....	.095	.176	.22
New Orleans.....	.12	.23	.36
Detroit (delivered).....	.070	.135	.225
Montreal.....	.09	.145	.30
Baltimore.....	.14	.25	.39
Atlanta.....	.0707	.1326	.....
Dallas.....	.115	.....	.....
Birmingham.....	.10	.17	.....
Pittsburgh (del.).....	.068	.128	.179

San Francisco, Philadelphia, Atlanta, New York, quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.....	1.60	$1.85	$2.58	$4.00	$2.57½	$2.48	$3.10
Channel, 3 to 15 in....	1.60	1.85	2.58	4.00	2.57½	2.48	3.10
Angles, 3 to 6 in., ¼ in. thick.....	1.60	1.85	2.58	4.00	2.57½	2.48	3.10
Tees, 3 in. and larger...	1.60	1.85	2.58	4.00	2.57½	2.48	3.10
Plates.....	1.60	1.85	2.58	4.00	2.57½	2.48	3.10

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	Warehouse: New York, Current	New York, One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	$2.25	$3.50	$4.65	$3.10	$3.09½	$4.50	$5.50
CONE HEAD BOILER							
½ in. and larger	2.35	3.60	4.75	3.20	3.19½	4.60	5.65
⅝ and ¾.....	2.50	3.76	4.90	3.35	3.35½	4.75	5.80
⅞ and 1.....	2.75	4.00	5.15	3.60	3.59½	5.00	6.05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.....	$2.40@.250	$3.15	$3.90	$5.00	$3.25	$4.95
Cut.....	2.25	5.80	5.90	7.75	....	5.00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square, f.o.b., as follows:

	New York: 1-Ply l.c.l.	New York: 2-Ply l.c.l.	New York: 3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	Philadelphia: 2-Ply l.c.l.	Philadelphia: 3-Ply l.c.l.
No. 1 grade....	$2.10	$2.55	$3.00	$1.90	$2.35	$2.80
No. 2 grade....	1.85	2.15	2.55	1.70	2.00	2.40

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.95 per roll in carload lots and $2.20 for smaller quantities f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.50 per square in carloads; $5.75 in smaller quantities, in Philadelphia.

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft.....	$2.00
Tar pitch (in 400-lb. bbl.), per 100 lb.....	1.60
Asphalt roofing (in barrels), per ton, f.o.b. plant*.....	40.50
Asphalt felt (light), per ton, f.o.b. plant*.....	64.50
Asphalt felt (heavy), per ton, f.o.b. plant*.....	68.50

* Delivered in Metropolitan Dist., $3.00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10.....	$2.40	$3.62½	$3.38	$4.15	$3.48
No. 12.....	2.45	3.67½	3.43	4.20	3.53
No. 14.....	2.50	3.72½	3.48	4.25	3.58
No. 16.....	2.70	3.82½	3.58	4.35	3.68
Black					
*Nos. 18 and 20.....	3.00	3.70	4.10	5.45	4.15
*Nos. 22 and 24.....	3.05	3.85	4.15	5.50	4.20
*No. 26.....	3.10	4.00	4.20	5.55	4.25
*No. 28.....	3.15	4.30	4.30	5.65	4.35
Galvanized					
No. 10.....	3.15	4.30	4.30	....	4.35
No. 12.....	3.25	4.40	4.40	5.60	4.45
No. 14.....	3.25	4.40	4.40	5.60	4.45
Nos. 17 to 21.....	3.55	4.60	4.70	5.90	4.75
Nos. 22 and 24.....	3.70	4.85	4.85	6.05	4.90
*Nos. 25 and 26.....	3.85	5.00	5.00	6.20	5.05
*No. 28.....	4.15	5.30	5.30	6.50	5.35

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Current	New York: One Year Ago	Chicago: Current	Chicago: One Year Ago
Raw in barrel (5 bbl. lots).....	$0.91	$0.80	$1.03	$0.75

WHITE AND RED LEAD—Base price in cents per pound:

	Red				White	
	Current		1 Year Ago		Current	Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	12.25	13.75	13.00	14.50	12.25	13.00
25 and 50-lb. kegs	12.50	14.00	13.25	14.75	12.50	13.25
12½-lb. keg	12.75	14.25	13.50	15.00	12.75	13.50
5-lb. cans	15.25	16.75	16.00	17.50	15.25	16.00
1-lb. cans	17.25	18.75	18.00	19.50	17.25	18.00

LUMBER

Prices wholesale to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$24.00	$24.00	$25.00	$30.00
3x6 and 8	25.00	25.00	26.00	31.00
4x4-6 and 8	25.00	26.00	27.00	32.00
3x10 and 12	25.00	26.00	27.00	32.00
3x14	29.00	30.00	31.00	33.00
4x10 and 12	25.00	26.00	27.00	32.00
4x14	29.00	30.00	31.00	33.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$27.00	$30.00	$32.00
6x14	29.00	32.00	34.00
8x10	27.00	30.00	32.00
8x14	29.00	32.00	34.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22–24 Ft.
3x 4 to 8x8	$38.00	$39.00	$39.00	$41.00
3x10 to 10x10	41.00	42.00	42.00	44.00
3x12 to 12x12	43.00	44.00	45.00	47.00
3x14 to 14x14	47.50	48.50	48.00	50.00
3x16 to 16x16	52.50	53.50	52.00	54.00
3x18 to 18x18	60.00	61.00	59.00	61.00
4x20 to 20x20	70.00	71.00	68.00	70.00

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under			12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$50.00	$52.00	$55.00	$45.00	$54.00	$52.00
Seattle		21.50	.....	.....	.....	21.50
New Orleans	26.50	.....	.....	.....	30.00	.....
Baltimore	36.45	.....	.....	.....	38.50	.....
Cincinnati	39.00	50.00	.....	.....	40.00	64.00
Montreal	78.00	*45.00*	35.00	35.00	*78.00*	47.00
Los Angeles	.....	44.00	43.00	.....	.....	44.00
Denver	.....	35.75	35.75	35.75	.....	36.75
Minneapolis	43.00	40.00	39.00	.....	47.00	40.00
Atlanta	32.00	.....	.....	.....	38.00	.....
Dallas	33.00	.....	.....	.....	34.50	.....
Kansas City	33.00	34.00	.....	.....	36.00	35.00
Birmingham	21.00	.....	.....	.....	26.00	.....
Philadelphia	36.50	39.00	42.00	47.00	46.50	38.50
Detroit	40.00	43.00	.....	.....	45.00	44.00
St. Louis	35.00	.....	.....	.....	38.00	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$47.00	$48.00	$32.00	$45.00	$48.00
Seattle	.....	17.00	.....	.....	19.50
New Orleans, at mill	70.00	.....	.....	17.60	.....
Baltimore	35.00	.....	.....	36.45	.....
Cincinnati	62.50	80.00	.....	33.50	.....
Montreal	*35.00*	48.00	35.00	80.00	45.00
Los Angeles	.....	37.00	36.00	.....	*45.00*
Denver	.....	30.75	30.75	.....	30.25
Minneapolis	42.50	37.25	35.25	38.75	37.75
Atlanta	20.00	.....	.....	23.00	.....
Dallas	34.00	30.00	.....	36.00	.....
Kansas City	35.00	34.50	.....	20.00	31.00
Birmingham	20.00	.....	.....	22.00	.....
Philadelphia	29.50	37.00	43.00	32.50	37.00
Detroit	42.00	33.75	.....	38.50	36.25
St. Louis	36.00	.....	.....	35.00	.....

Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.

Birmingham—Quotes carload lots, f.o.b. sidings. $2.00 additional per M. ft. to con ractor.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractor on large projects.

St. Louis—Wholesale price to contractors, $4.50@$6 per M ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.35	Detroit	$0.32
Birmingham	.76½	Kansas City	.81½
Boston	.40½	New Orleans	.51½
Buffalo	.29½	New York	.38
Chicago	.38	Pacific Coast (all rail)	1.66½†
Cincinnati	.32	Philadelphia	.36
Cleveland	.24	St. Louis	.47½
Denver	1.32*	St. Paul	.66

* Minimum carload, 40,000 lb.

†Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2.00	$2.00	$2.55

WIRE ROPE—Discounts from list price on regular grades of bright and galvanised are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	30%
Patent flattened strand, special and cast steel	30%
Patent flattened strand, iron rope	15%
Plow steel round strand rope	45%
Special steel round strand rope	40%
Cast steel round strand rope	32½%
Round strand iron and iron tiller	15%
Galvanized steel rigging and guy rope	17½%
Galvanized iron rigging and guy rope	+2½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft., ½-in., 6; ¾-in., 4½; 1-in., 3½; 1½-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¼-in. and larger, in 1200-ft. coils:

Boston	$0.20	New Orleans	$0.17½
New York	.17	Los Angeles	.16½
Chicago	.19	Seattle	.18
Minneapolis	.19½	St. Louis	.21
San Francisco	.17	Montreal	.30
Atlanta	.21	Detroit	.19½
Denver	.20	Baltimore	.20
Cincinnati	.20	Kansas City	.18½
Dallas	.29	Birmingham	.20½
Philadelphia	.17@.18		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.2950	$0.3250
Boston	.24	.275
Kansas City	.24	.2750
Seattle	.1875	.2125
Chicago	.2450	.2750
Minneapolis	.2144	.2347
St. Louis	.2475	.2775
Denver	.2250	.2550
Dallas	.29	.375
Los Angeles	.23	.26
Atlanta	.2575	.2875
Baltimore	.2550	.27
Cincinnati	.2350	.255
Montreal	.215	.255
Birmingham, *delivered*	.155	.175
New Orleans	.2725	.3075
San Francisco	.195	.23
Philadelphia	.24	.27

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.13	$0.17½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$13.00	$11.50	$12.00
Stove plate	12.50	12.00	13.50
No. 1 machinery cast	18.00	16.50	14.50
Machine shop turnings	7.00@7.50	4.00	5.00
Cast borings	9.00@9.50	5.50	6.75
Railroad malleable cast	11.00	12.50	10.25
Re-rolling rails	11.50@12.00	13.00	15.00
Relaying rails	28.50@28.50	30.00	15.00

SHIP SPIKES—Current prices per 100 lb.:

	San Francisco Galv.	San Francisco Black	Seattle Black
In.			
½	$6.75	$5.50	$8.55
⅝	6.30	5.05	8.25
¾	6.15	4.90	8.30

Pittsburgh base in lots of 200 kegs or more $2.50